Iron and Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

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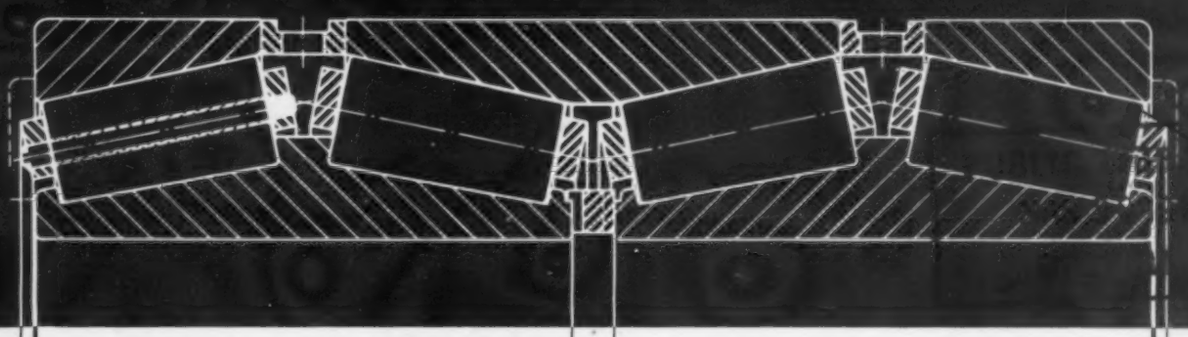


HOW TO GET EVERYTHING THERE IS IN ROLL NECK BEARING EFFICIENCY, ECONOMY, ENDURANCE

Every modern requirement in roll neck bearings is provided by Timken Balanced Proportion Bearings.

They assure smooth, friction-free operation under every condition of speed and load.

They contribute importantly to maximum mill rigidity and minimum roll deflection by permitting the use of larger roll necks (average size, 71% of the O.D. of the bearing).

They permit re-starting of mills under full load after routine or emergency stoppages without disturbing the gauge setting of the rolls, losing steel or damaging the bearings.

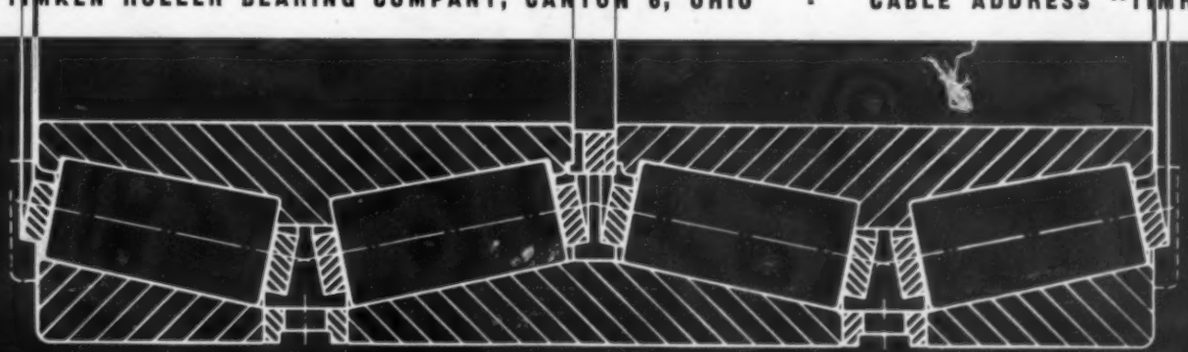
They enable rolls to be changed easier in less time because there is no complicated lubrication system to hamper roll changing.

They employ the simplicity, directness and economy of grease lubrication.

Are you getting all these roll neck bearing advantages in your present rolling mills? Will you have them in your new mills? You can have them in both existing and new equipment through Timken Balanced Proportion Bearings. Specify them.

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
ROLL NECK BEARINGS

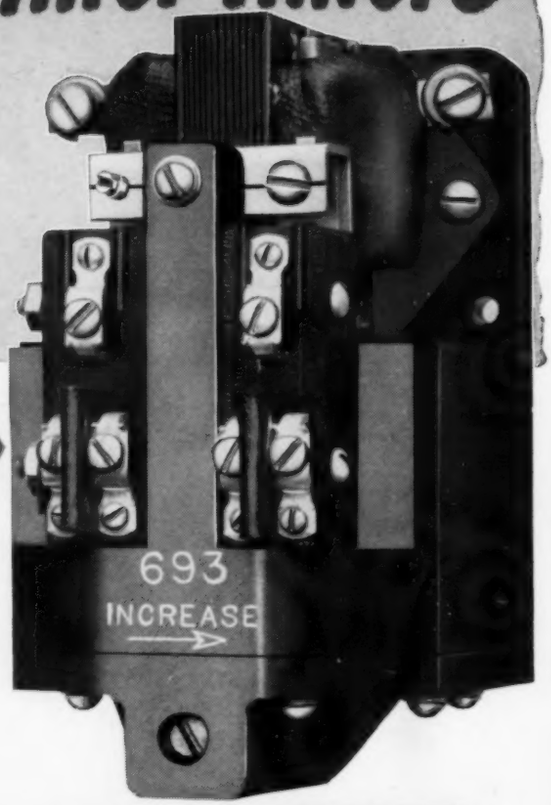
THE TIMKEN ROLLER BEARING COMPANY, CANTON 6, OHIO · CABLE ADDRESS "TIMROSCO"



For machine designers . . .

2 New Cutler-Hammer Timers

- SMALL SIZE
- EASY TO ADJUST
- ACCURATE AND DEPENDABLE



BULLETIN 10337 A. C. PNEUMATIC TIMER

Designed for a broad variety of industrial control timing needs, such as machine tools, conveyors, automatic processing equipment, etc. Its extremely small size, 2¾ wide x 4⅞ high makes it desirable where space is at a premium. Its timing adjustment is especially simple, made with a screw driver from the front. 8 turns of the screw gives the entire timing range from 0.3 seconds to 3 minutes. Reset is practically instantaneous. Available either with one timing step or two timing steps, the two steps eliminate the need of one timing relay. The two steps of timing are independently adjustable over the entire range.

BULLETIN 13522 GENERAL PURPOSE ELECTRONIC TIMER

For use particularly where short or very accurate timing is required. The standard unit has a wide timing range, from 0.15 to 60 seconds. Shorter time settings or narrower ranges can readily be provided for special applications. Timing adjustment is easily made by turning knob of potentiometer rheostat which is equipped with a clearly graduated dial. The rheostat may be located inside the timer enclosure or at any convenient place on the machine remote from the timer. A heavy duty industrial type relay is used in the timing circuit. An outstanding feature is the extreme accuracy of the unit on repeat operations and under varying ambient temperature conditions.

For further information on Bulletin 10337 pneumatic timer, or Bulletin 13522 electronic timer, write CUTLER-HAMMER, Inc., 1269 St. Paul Ave., Milwaukee 1, Wisconsin. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ont.

CUTLER-HAMMER
MOTOR CONTROL
C-H

IRON AND STEEL ENGINEER, published monthly by Association of Iron and Steel Engineers, 1010 Empire Bldg., entered as second class matter January 25, 1924 at Pittsburgh, Pennsylvania, under Act of Congress March 3, 1879. $7.50 per year in United States and Canada, $10.00 foreign countries. Volume 26, No. 3.

TECHNOLOGY DEPARTMENT

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DETROIT

MORE *continuous butt weld pipe mills than all companies combined*

● Aetna-Standard has more knowledge, more facts, more figures, more experience on continuous butt weld pipe mills than any other company.

Judgment for capital equipment requires undiluted facts and specific figures to prove the soundness and need for the investment. From Aetna-Standard you will know how much tonnage you can expect . . . by the month, the year or by the hour . . . in your specific pipe sizes.

Aetna-Standard designs, engineers and builds continuous butt weld pipe mills *complete* from coil storage through the shipping department, including all component parts. Illustrated here (top to bottom) are major units: uncoiler, skelp feeding, roller leveller, sizing mill and forming and welding mill.

In our shops at Ellwood City, Pa., and Warren, Ohio, three more complete continuous butt weld pipe mills are under construction. *Place your confidence in the company which has built more continuous butt weld pipe mills than all other companies combined.*

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YOUNGSTOWN, OHIO

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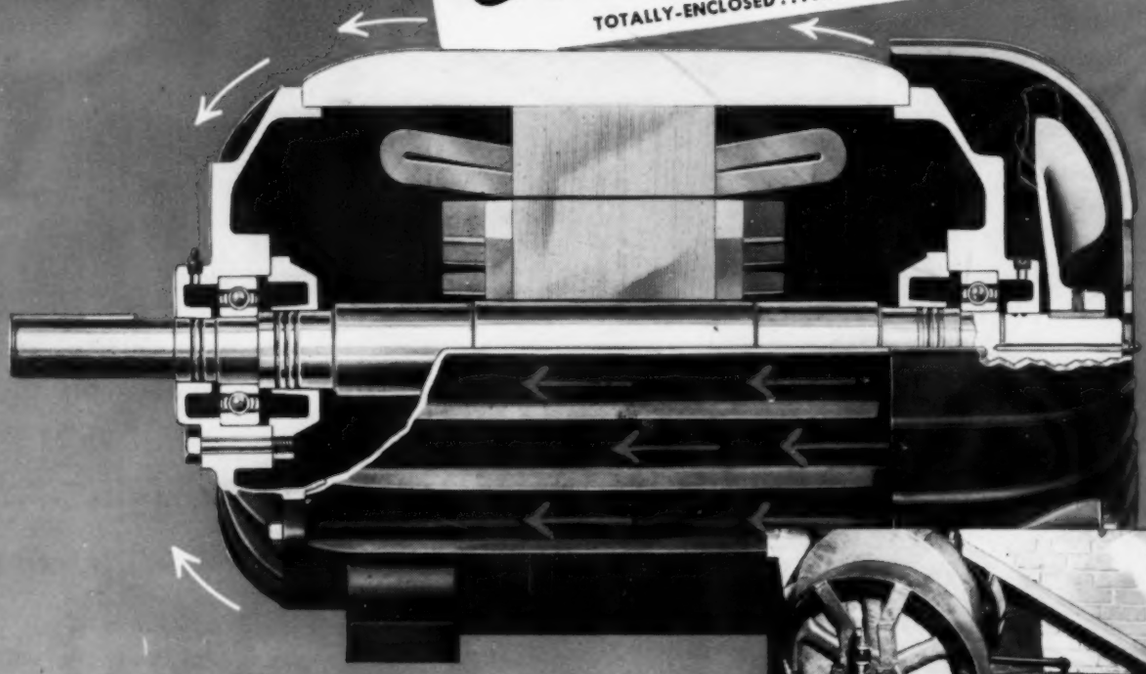
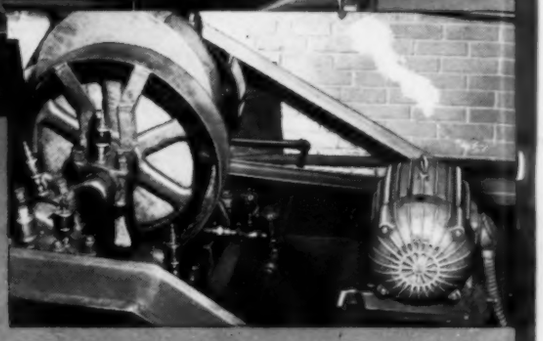
CROCKER-WHEELER Sealedpower MO...

TOTALLY-ENCLOSED . . . FAN-COOLED





Sealedpower Motor driving a vertical triplex power pump where moisture is excessive.

Saves 80% of Maintenance Costs

You can make maintenance savings of 80% and *more* with Crocker-Wheeler Sealedpower Motors. The secret? C-W dollar-saving design. No other totally-enclosed, fan-cooled motor has *exterior* cooling, with the fan-driven airstream blowing over a finned frame, carrying dust and fumes *outside* and *away*. (The outside fins that identify a Sealedpower Motor provide over 150% more cooling surface.)

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For years of cool, clean operation and low maintenance cost, specify Sealedpower Motors. They're stock motors made for the toughest service. In new ratings from 3 to 60 hp.

Crocker-Wheeler Electric Manufacturing Company, Ampere 3, N. J. Division of The Joshua Hendy Corp., Branch Offices: Boston, Buffalo, Chicago, Cincinnati, Cleveland, Los Angeles, Milwaukee, New York, Philadelphia, Pittsburgh, San Francisco, Washington, D. C. Representatives in principal cities.

SEND FOR BOOKLET, "It's Different — it's a Dollar-Saver." Tells why the Sealedpower Motor will save money for you.

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If Crocker-Wheeler builds it, it's a better built machine.

Horizontal and Vertical Protected-Type Induction Motors

A-C Generators and High Speed Synchronous Motors

Large D-C Motors and Generators

Turbogenerators

CROCKER WHEELER

ELECTRIC MANUFACTURING COMPANY, AMPERE 3, N. J.

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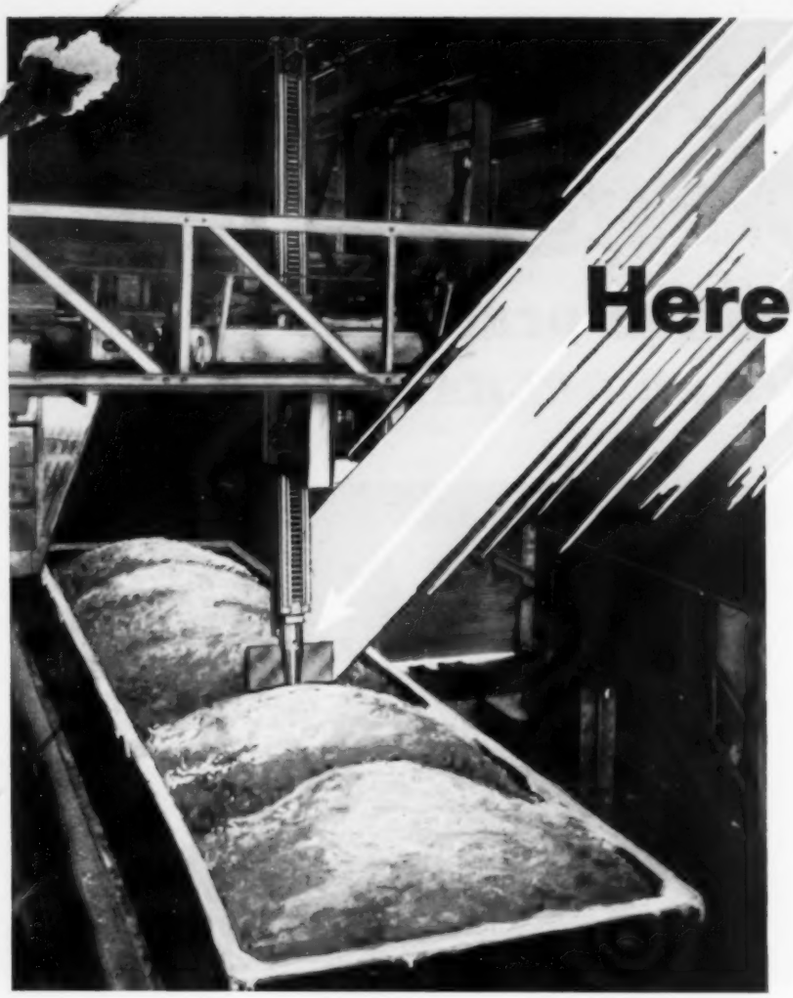

Here's a Ray of Sunshine

on the Problem of *Unloading* Hopper Cars of FROZEN COAL

At last a device is available for unloading Hopper Cars of Frozen Coal without the use of heat and without damage to the cars.

The photograph shows a Kinney Car Unloader, manufactured and sold only by Heyl and Patterson, in operation on a carload of frozen coal at the Marysville Power Plant of The Detroit Edison Company.

The Kinney Car Unloader, which can also be used in a limited way as a Car Mover, consists of a movable bridge equipped with a trolley which carries the Unloading Spade and its operating mechanism. The bridge may run on a Crane Runway or may be designed as a Gantry or other type of bridge.

The coal is unloaded through the normal hopper openings in the bottom of the car. By a coordinated movement of the trolley and the bridge it is possible to place the spade in any position over the car.

Sufficient force can be applied to the ram carrying the spade to drive it down through frozen coal, forcing it through the hopper openings.

The spade can swing through an arc and move coal down into the opening previously made.

With the Kinney Car Unloader, one man can unload a 70-ton car of frozen coal in 20 minutes or less.

The Kinney Car Unloader is manufactured and sold only by Heyl and Patterson. Ask an H & P Engineer to consult with you on your problem of unloading hopper cars of frozen coal.

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your lubrication practices...

it's a means to LOWER OPERATING COSTS

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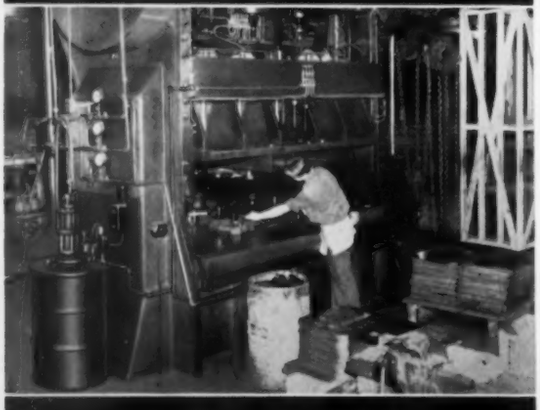
LUBRICATING
SYSTEMS

from the simplest manual system



...to complete automatic systems

849-7

Today's demands for higher efficiency and lower maintenance costs create new responsibilities for everyone responsible for production and plant operation.

Lubrication practices utilizing equipment that provides a *system* of lubrication designed for each particular requirement, contribute the ultimate to low operating costs by combining operating economies with increased production rates, quality control, and longer machine life.

You automatically improve your lubrication practices when you standardize on Lincoln Lubricating Equipment. This proven line offers you a selection, from a wide range of complete systems, for the periodic manual application of lubricants or for fully automatic, time-controlled, and powerized systems dispensing fixed quantities of lubricants at predetermined time intervals under a wide range of temperature conditions.

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- **In the right quantity**
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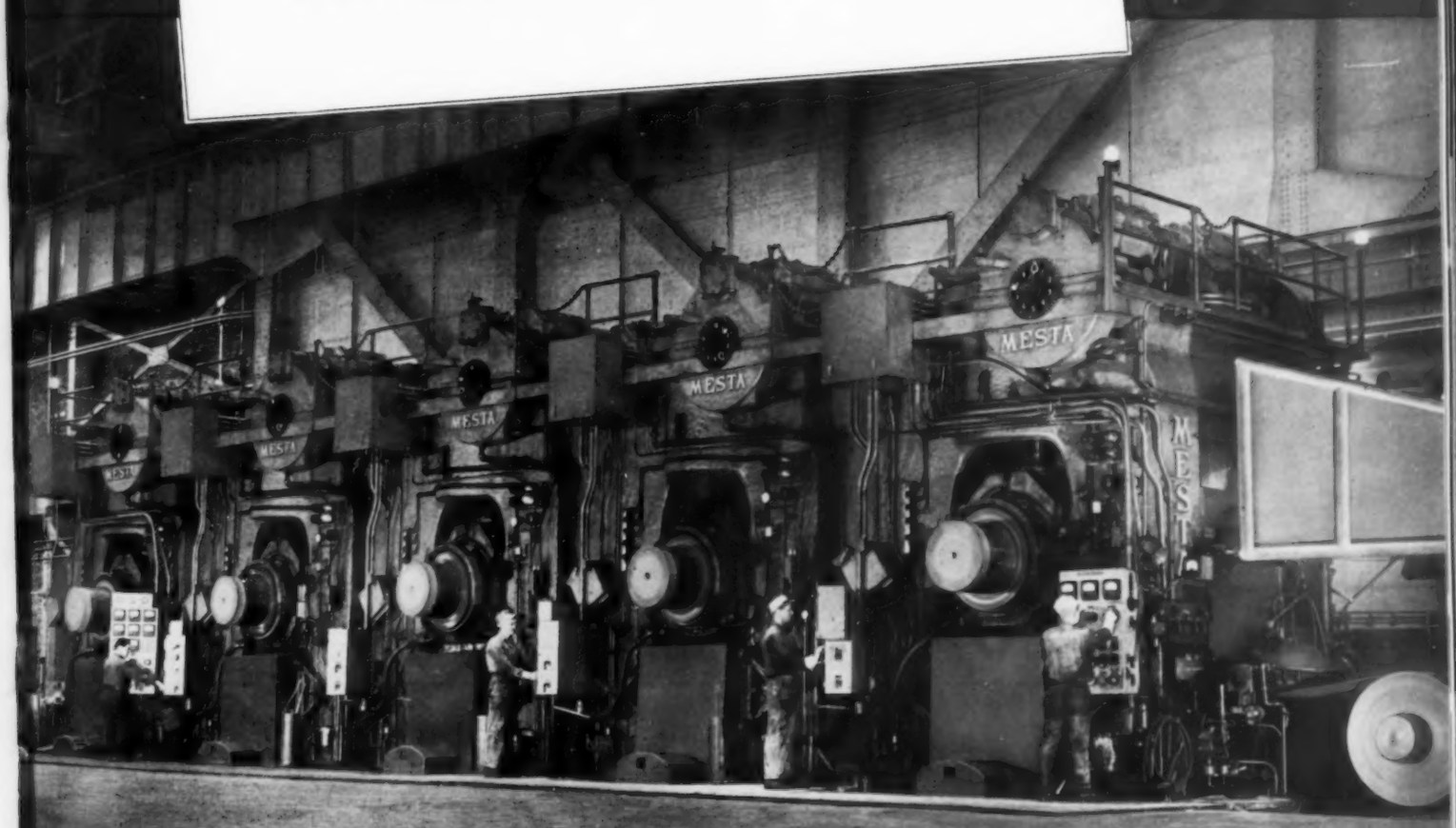
MODERN HIGH SPEED COLD MILL . . .

Designed and Built by

MESTA



The World's Highest Speed Cold Mill . . . Mesta 42" Four-High, Five-Stand Tandem Cold Mill installed at Jones & Laughlin Steel Corporation, Aliquippa Works

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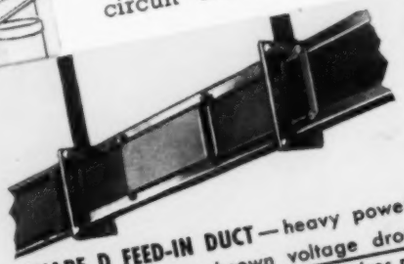
POWER YOU NEED . . .

Where you need it
When you need it

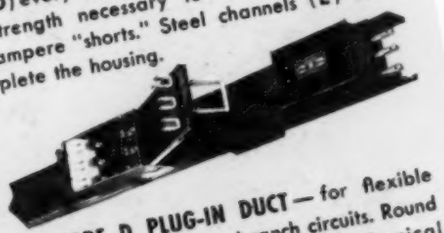
• Electrical power is becoming more and more important in modern production methods. It's needed in larger amounts at many and varying locations dependent upon shop layout and machine arrangement. Square D's Feed-in and Plug-in Duct are a combination with an outstanding performance record in hundreds of plants throughout the country. Feed-in Duct handles heavy loads characteristic of large feeder circuits with high efficiency and low voltage drop. Plug-in Duct permits protected branch circuit "take-offs" at frequent intervals along the length of the duct.



SQUARE D FEED-IN DUCT—heavy power feeder with lowest known voltage drop characteristics. Exclusive design requires no ventilation for limiting temperature rise—permits completely enclosed, dust-excluding structure. Rigid construction resists heavy electrical stresses. Absence of all-metal enclosure eliminates "hum" and iron losses.

"One-split" bus (A), with halves positioned on either side of other two busses, permits close spacing and electrical symmetry important to reduction of both energy loss and voltage drop.

Solid ebonized asbestos insulating plates (B) and (C) which totally enclose bus, have great mechanical and high dielectric strength, conduct heat readily, are impervious to moisture and resistant to arc. Surge clamps (D) every 24" give structural and mechanical strength necessary to withstand 50,000 ampere "shorts." Steel channels (E) complete the housing.



SQUARE D PLUG-IN DUCT—for flexible power distribution to branch circuits. Round bus bars provide greater mechanical strength and resistance to short circuit stresses. Steel enclosure and rotating doors over plug-in openings exclude dust and dirt.

Plug-in units are easily attached. Powerful contact jaws, affording positive pressure, can be "rocked" into position on bus bars. Five units may be attached to either side of each ten-foot section. Flexible couplings join Plug-in bus bars—absorb expansion or contraction and eliminate section alignment problems.

A quick glance tells you *what* Square D Feed-in and Plug-in Duct do. It takes a closer look to learn *how* they do it and *why* they do it better. Your nearby Square D Field Engineer will be glad to give you the complete story. Or write for detailed information.

Address: Square D Company, 6060 Rivard St., Detroit 11, Michigan.

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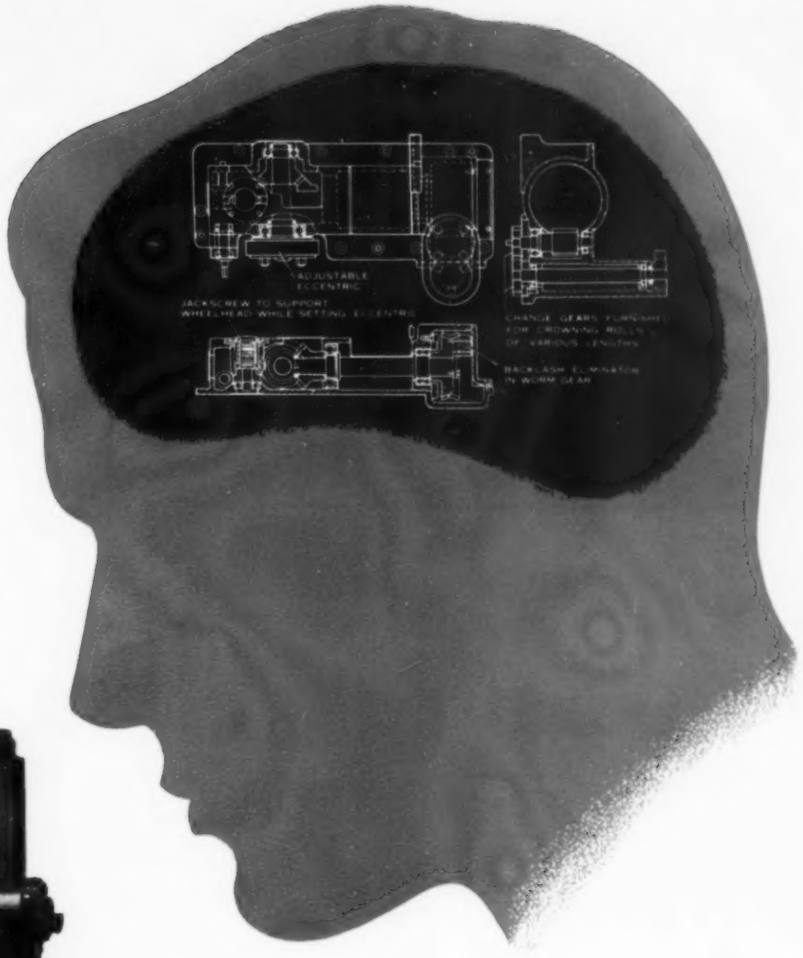
AN INFALLIBLE EXPERT . . .

at crowning or concaving rolls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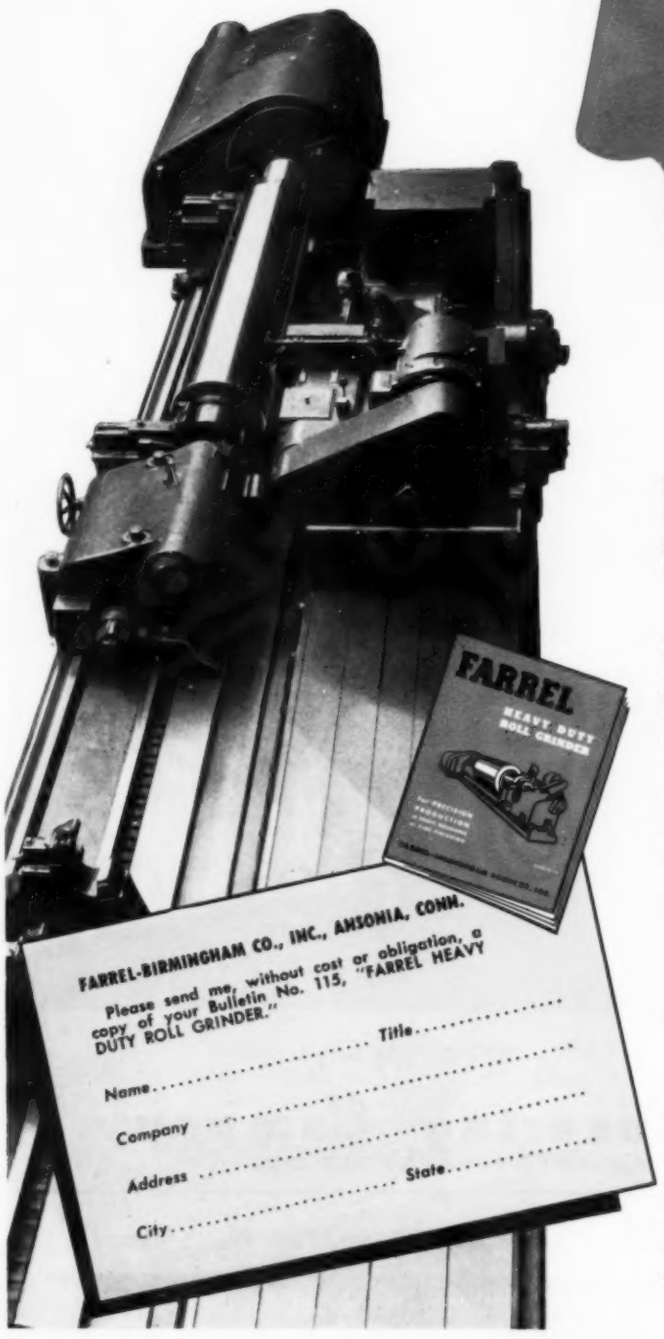
JACKSCREW TO SUPPORT WHEELHEAD WHILE SETTING ECCENTRIC
CHANGE GEARS FURNISHED FOR CROWNING ROLLS OF VARIOUS LENGTHS
BACKLASH ELIMINATOR IN WORM GEAR


FARREL
HEAVY DUTY ROLL GRINDER
FARREL-BIRMINGHAM CO., INC., ANSONIA, CONN.
Please send me, without cost or obligation, a copy of your Bulletin No. 115, "FARREL HEAVY DUTY ROLL GRINDER."
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Farrel roll grinders have a patented, automatic crowning and concaving device, a built-in "brain," which guides the grinding wheel along a perfectly graduated, mathematically accurate curve.

The curve produced is of the correct shape for a crowned or concaved roll, exactly symmetrical on both halves of the roll. The same setting invariably results in exactly the same curvature, and permits fixed, uniform and easily controlled accuracy of contour in all rolls.

Of the adjustable, single eccentric type, the device is designed for ease and simplicity of setting and produces the curvature desired without any manipulation on the part of the operator. The eccentric and change gears are readily accessible so that settings for any curve can quickly be made.

This is only one of the many outstanding advantages of Farrel heavy duty roll grinders. For the complete story, send for a copy of Bulletin 115. Just fill out the coupon and drop it in the mail.

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Farrel-Birmingham

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24 Circular Soaking Pits BY SALEM

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MAY WE HAVE THE OPPORTUNITY OF STUDYING YOUR REQUIREMENTS AND SUBMITTING OUR RECOMMENDATIONS

MANUFACTURERS OF ROLLS AND ROLLING MILL MACHINERY FOR THE IRON, STEEL AND NON-FERROUS INDUSTRIES

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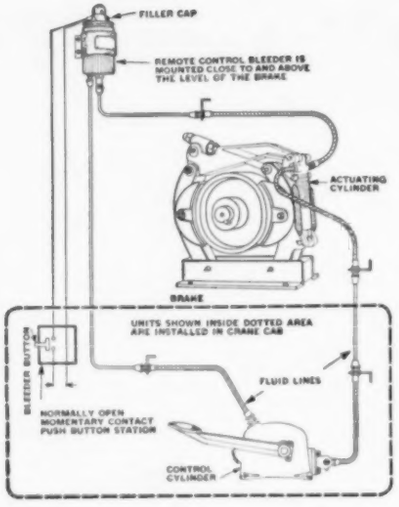
HYDRAULIC BRIDGE BRAKES did the trick....

and only Wagner Crane-Bridge Brakes give you these features: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REMOTE CONTROL BLEEDER IS MOUNTED CLOSE TO AND ABOVE THE LEVEL OF THE BRAKE
ACTUATING CYLINDER
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UNITS SHOWN INSIDE DOTTED AREA ARE INSTALLED IN CRANE CAB
BLEEDER BUTTON
FLUID LINES
NORMALLY OPEN MOMENTARY CONTACT PUSH BUTTON STATION
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● A Size and Type for Every Application . . .

Wagner hydraulic crane-bridge brakes are built, with or without parking attachment, in four sizes that are capable of handling any application—from light industrial cranes to the largest steel mill ladle crane.

● Remote Control Bleeder . . .

Keeps lines full of fluid, even when brake is installed at a considerable height above the control cylinder. Maintains peak braking efficiency, and makes bleeding the system an easy, "one man" job.

● Self-Centering Device . . .

Prevents brake shoe drag by assuring equal clearance of *both* brake shoes.

● Other Advantages Include . . .

Power failure braking . . . one-point shoe adjustment . . . 200% emergency torque . . . grease fittings for lubrication . . . non-scoring, easily replaceable molded lining blocks.

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If your cranes are not equipped with Wagner brakes, one of our field engineers will gladly show you how simple it is to install a modern hydraulic system.

If you now have Wagner brakes, your system can be quickly modernized with our complete conversion kits. You can change your old solenoid-controlled HM brake to the compact, hydraulic type; you can convert a type H brake to an HM; and you can easily add the remote control bleeder to any Wagner system.

Bulletin IU-40 gives full information on Wagner Industrial Brakes—write for copy.

Wagner Electric Corporation

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Consult Wagner Engineers on all Crane-Bridge Braking Problems

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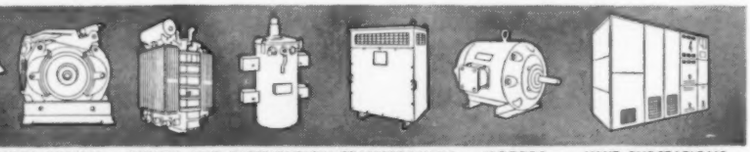

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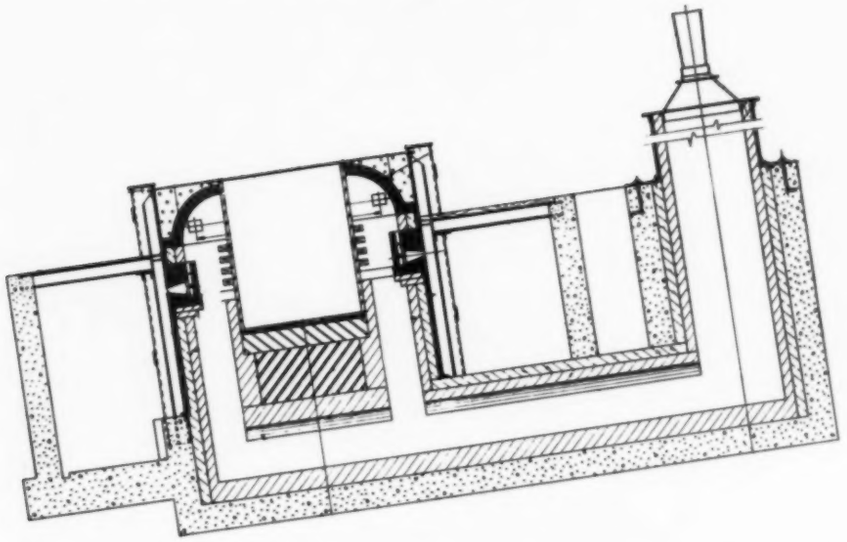

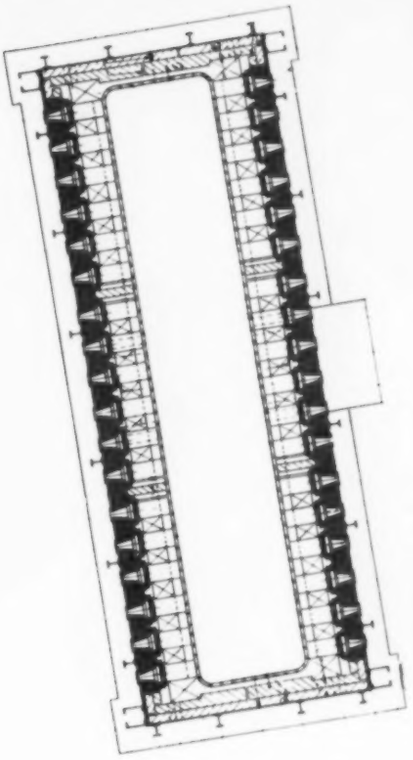

F. E. I. SETTING
for Galvanizing Furnaces

In a large steel plant on a pipe galvanizing furnace where the expected life of the kettle was 20,000 tons of galvanized pipe, this new setting produced 70,000 tons before the kettle was replaced. For the same tonnage no repairs whatever were required for the setting until a new kettle was installed. There was a pronounced reduction in the overall fuel used per ton because this new setting allows for the minimum of fuel during the idling period which usually occurs for about 2 days every week. Details of this setting will be cheerfully furnished upon request.

U. S. PATENTS 2,446,642; 2,403,431; 1,913,170.
OTHER PATENTS PENDING.

F.E.I. Builds:

Open Hearth Furnaces; Soaking Pits; Continuous Bloom, Billet and Slab Heating Furnaces; Direct Fired Cover Furnaces for sheet and coil annealing; Salt Descaling Furnaces for stainless steel sheet, bar and other products; Heat Treating Furnaces for every use; Galvanizing Furnaces for tubes, sheet and metalware.

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FIRING BIG FURNACES WITH GAS?
A Micromax "Team" Will Dole It Out—Accurately!

The Spang-Chalfant Division of The National Supply Co. heat-treats big batches of two-ton drill collars in this efficient Hagan Furnace. Its Micromax Controllers regulate temperatures accurately — and thriftily. Circle shows couples and burner ports; below is Micromax Control room.

Accurate and thrifty control for big, multi-zone furnaces requires a pyrometer setup which has a quality one might call "teamwork." Here are some of the ways we provide it:

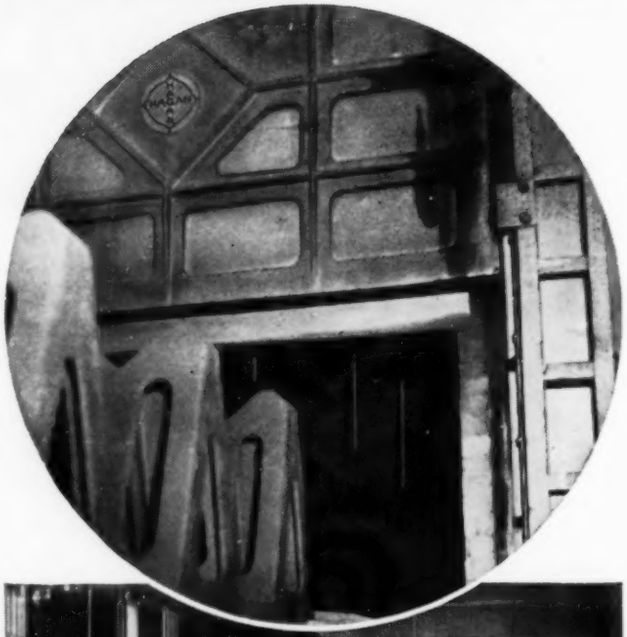
1. Pyrometers can be either Micromax or our new Type G Speedomax, depending on requirements of the process and preference of the user. We'll help with the selection if you wish; either instrument will give the reliable performance which L&N potentiometers pioneered and have maintained for almost a generation.

2. Each instrument can be initially set to the exact requirements of its furnace zone . . . no matter how widely these vary. Each then holds temperature on the mark, regardless of changes in load, ambient temperature, etc.

3. No attention is required to keep all Controllers at the same accuracy. Each standardizes itself every forty-five minutes. All members of the "team" are therefore always accurately in step.

4. Efficient combustion, proper furnace atmosphere and correct furnace pressure can all be tied into the L&N temperature control for cost-cutting operation at high production levels.

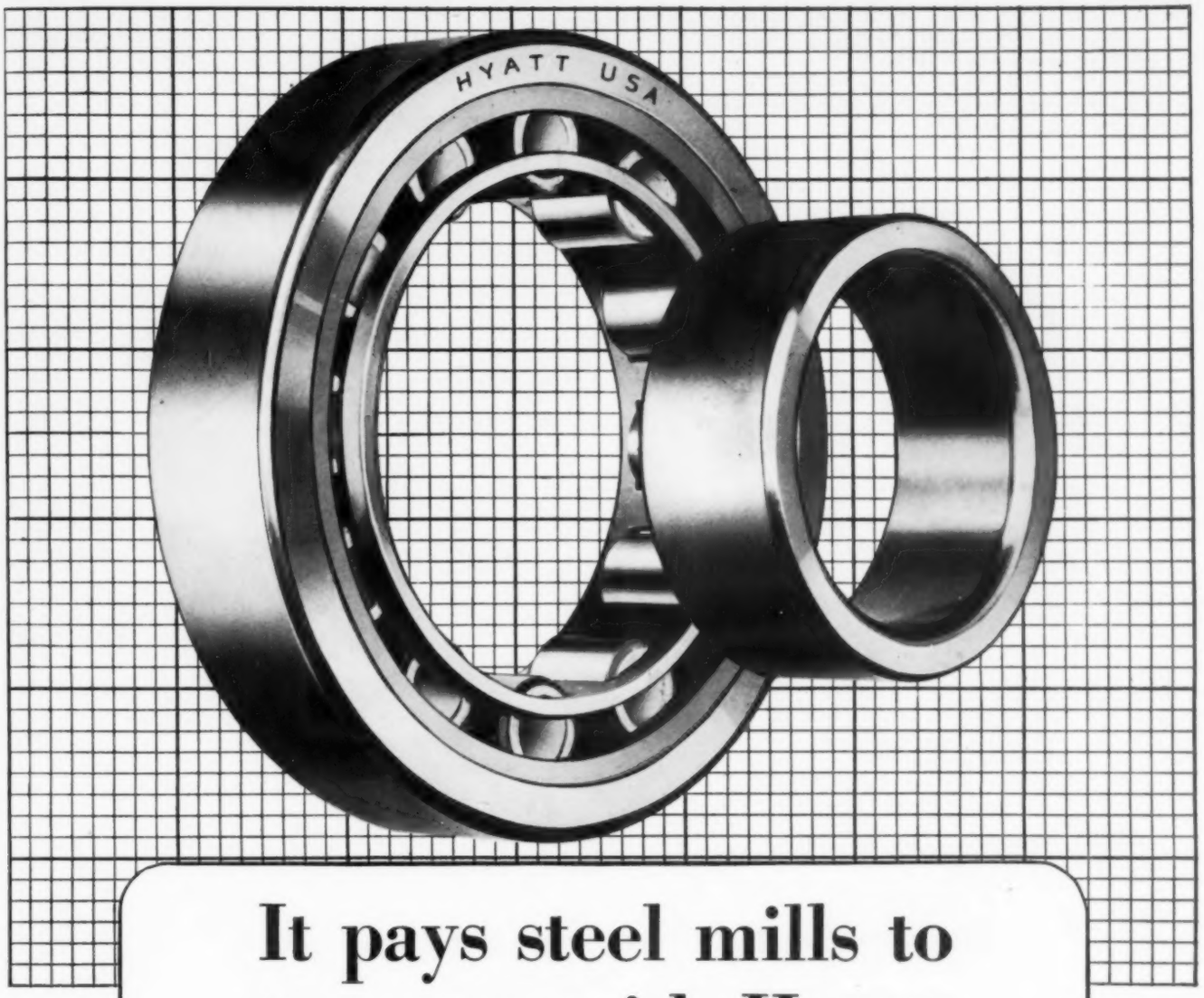
For further information, write Leeds & Northrup Company, 4942 Stenton Ave, Philadelphia 44, Pa.



LEEDS & NORTHRUP

MEASURING INSTRUMENTS · AUTOMATIC CONTROLS · TELEMETERS
HEAT-TREATING FURNACES

Jrl. Ad N-33A-621(1)



It pays steel mills to team up with Hyatts

FOR EXAMPLE—90% of the ingot mold and charging box cars used in open hearth plants are equipped with Hyatt Roller Bearings. Why? Because wear is reduced—fewer broken axles—longer trains are handled quicker—less draw bar pull required.

In tables, cranes, motors and other mill equipment Hyatts have given excellent performances. Hyatts are built to take the tough loads.

For the past thirty years steel mills have shown a marked preference for Hyatt Roller Bearings because they have proved to their own satisfaction that it has paid them to team up with Hyatts. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

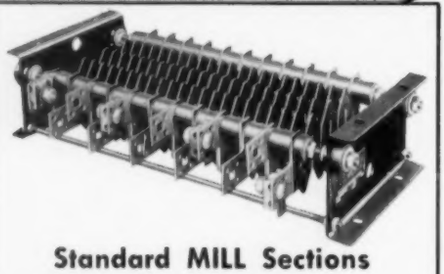
HYATT ROLLER BEARINGS

Two-way Improvement with EC&M *TAB-WELD* Resistors

1 - STABILIZES the resistance value.

2 - ELIMINATES TROUBLE in concealed areas.

OFF-SET in each plate gives Intimate Contact at grid-eyes SPOT-WELDS insure continuous path independent of clamping-nuts



Standard MILL Sections have these features . . .

1. All grids in series—all grids of the same size.
2. Capacities up to 150 amperes per section. External paralleling of sections for larger capacities as needed.
3. Uniform mounting-hole dimensions.
4. Replacement simplified — taps in place for affixing external leads.

Usually mounted overhead or in other remote locations, electrical resistors often receive little inspection or preventative maintenance until the damage has been done. But now, the problem of burning at grid-eyes, at tap-plates, and the need for periodic tightening of clamping-nut pressure is eliminated with EC&M *TAB-WELD* Plate Resistors.

Unlike previous resistor-sections depending on end-nuts for contact-pressure, these new EC&M Resistors are designed with *Tab-ends* which are spot-welded to give a *continuous* path throughout each section. Tap-plates also, are welded in position at frequent intervals for affixing external leads. Only EC&M *TAB-WELD* Plate Resistors offer these improvements for lower up-keep—prolonged life. *And don't overlook the corrosion-resistant properties of these steel plate resistors.*

When replacing existing installations or making new layouts, use EC&M Bulletin 942 *TAB-WELD* Plate Resistors

THE ELECTRIC CONTROLLER & MFG. CO.
2698 EAST 79TH STREET • CLEVELAND 4, OHIO

BIG CRANES

For fifty years, The Alliance Machine Company has been a leader in the designing, engineering and building of giant cranes for heavy industry. Many safety and mechanical features now accepted as standard practice in steel mill cranes, were first introduced by Alliance. In open hearth cranes, these features include interlocked drums, synchronized worm drive, 4-girder bridge construction, safety rope reeving and laminated ladle hooks. For increased safety, these hooks are equipped with universal joints at the top, permitting them to swing freely in any direction, thus preventing the hooks from bending and shearing rivets due to accidental collision.

The Alliance Machine Company has designed and built thousands of big cranes of all types to move heavy loads safely and economically. Give us an opportunity to solve your crane problems.

THE ALLIANCE MACHINE COMPANY

MAIN OFFICE
ALLIANCE, OHIO

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1622 OLIVER BUILDING, PITTSBURGH, PA.

LADLE CRANES • GANTRY CRANES • FORGING MANIPULATORS • SOAKING PIT CRANES
STRIPPER CRANES • SLAB AND BILLET CHARGING MACHINES • OPEN HEARTH CHARGING MACHINES • SPECIAL MILL MACHINERY • STRUCTURAL FABRICATION

Would You Like 100 Tireless Hand·Chippers For Your Billet·Shed?

IT'S A MAN·KILLING JOB . . .

LET THE BILLETEER DO IT...

One hand chipper can remove a 12" chip in 60 seconds of ear-splitting, grueling work, whereas . . .

A Bonnot Billeteer operator removes a 12" chip in 2 seconds, as the 45-ton machine responds to his finger-tip control. Electric and hydraulic power activates the carriage, roll-table, chucking, turn-over, feed and turnout units. There's practically NO OPERATOR FATIGUE—no let-up in the steady output.

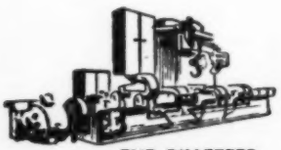
Safety-wise, a recent survey revealed that in 490,000 Billeteer hours of operation, only one man was involved in a disabling accident—A TRULY-TERRIFIC BILLET-SHED SAFETY RECORD.

MEN LIKE TO OPERATE BONNOT BILLETEERS. They decrease employee turnover in your billet-shed and boost efficiency and output.

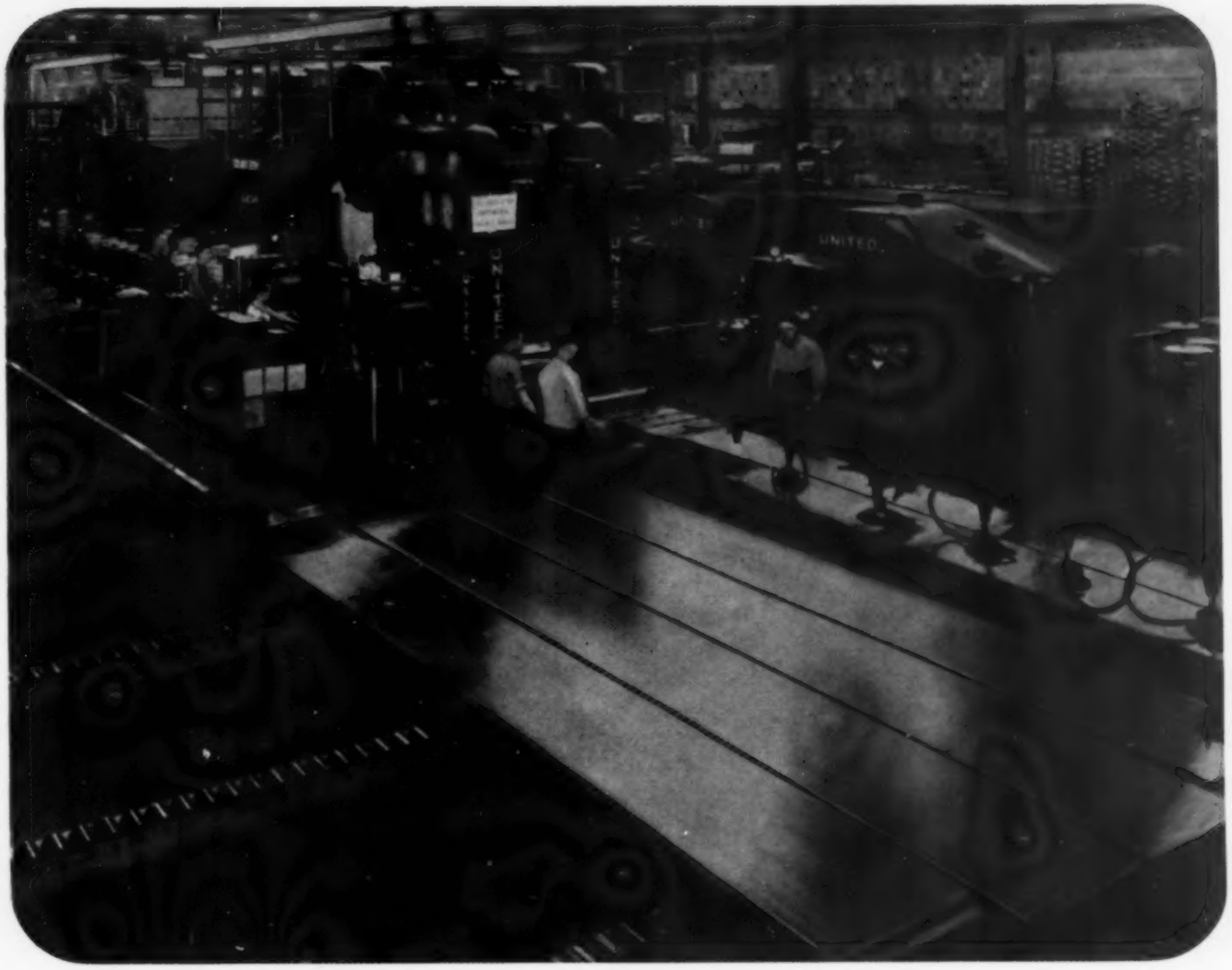
Write today for complete information. A Bonnot engineer will give your inquiry his personal attention.

Engineered for Improved Production

The Bonnot Co.
STEEL EQUIPMENT DIVISION
CANTON 2, OHIO



THE BILLETEER



2 STAND, 4 HIGH TANDEM BRASS MILL

. . . for rolling brass sheet and plate for watch parts, door hardware, housewares, lamps, novelties, etc.

Designed and built by

UNITED

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PITTSBURGH, PENNSYLVANIA

PLANTS AT: PITTSBURGH · VANDERGRIFT · NEW CASTLE · YOUNGSTOWN CANTON

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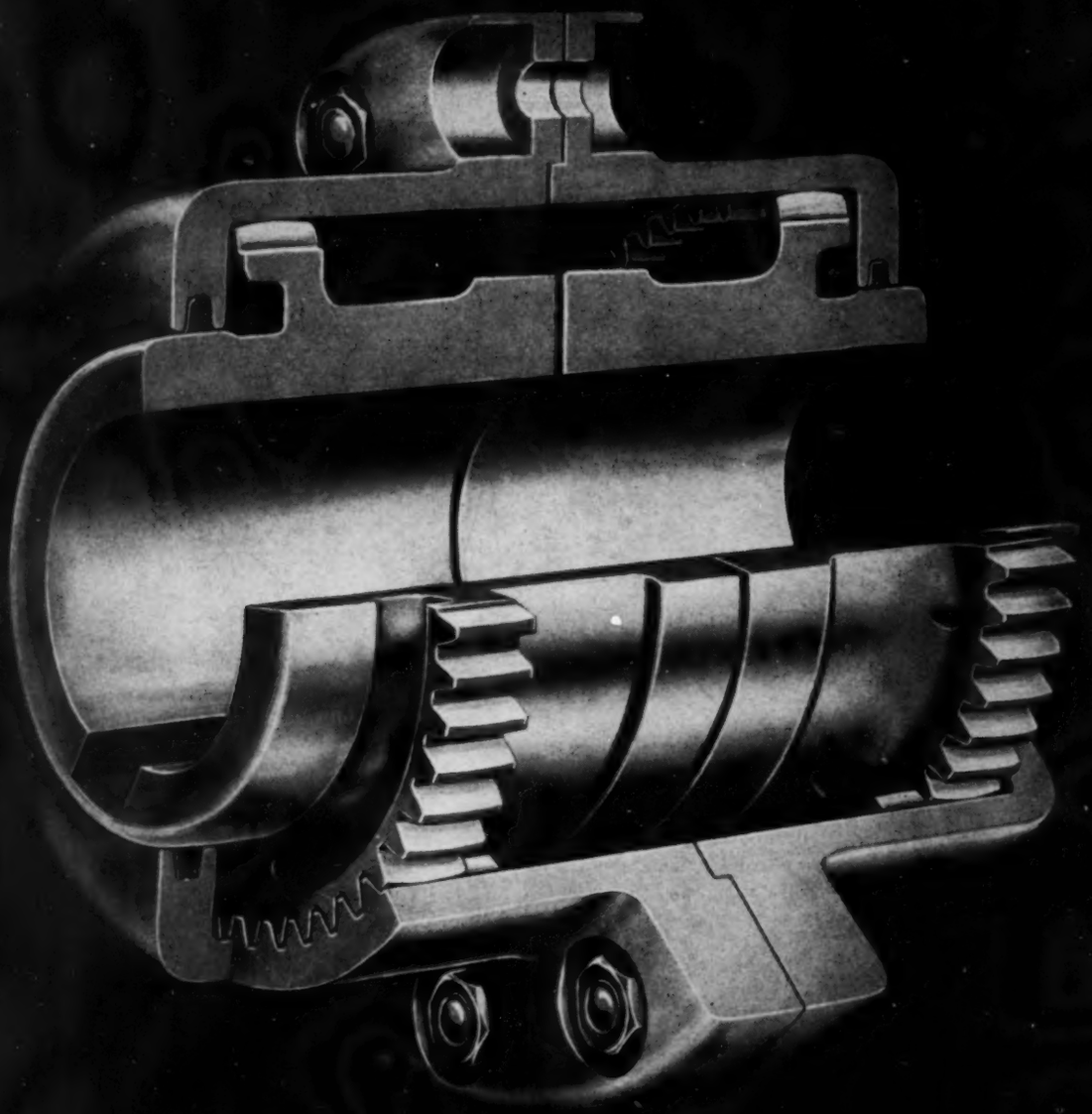
POOLE



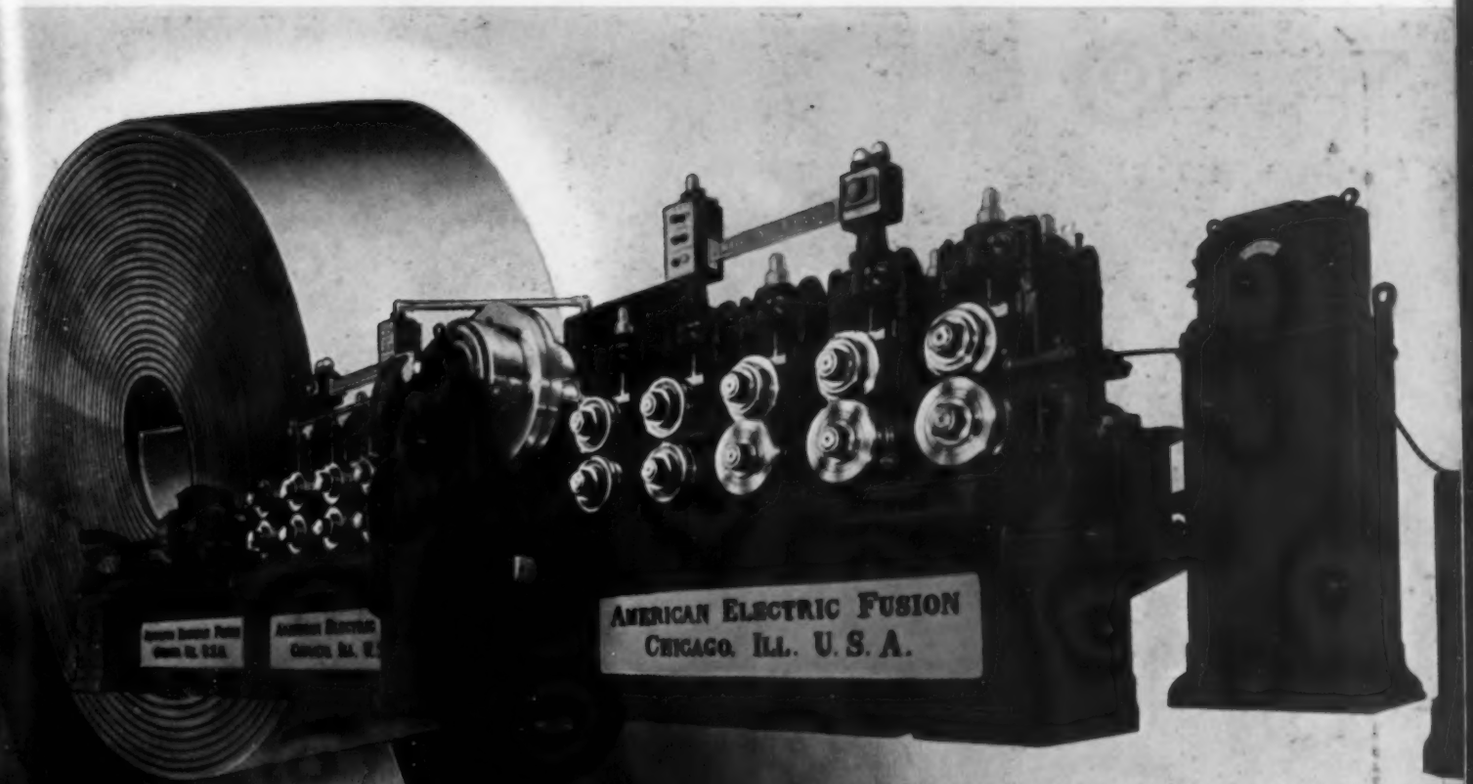
A COPY OF CATALOG GIVING FULL DESCRIPTION AND ENGINEERING DATA SENT UPON REQUEST.

FLEXIBLE COUPLINGS

POOLE FOUNDRY & MACHINE COMPANY

WOODBERRY, BALTIMORE, MD.

For Lowest Cost Steel Tubing



...matically converts strip steel, including stainless, ... perfectly welded tubing or pipe at high speeds. The most economical tube manufacturing unit available, an A.E.F. Tube Mill will pay for itself in less than a year.

Roll Your Own on

A.E.F.
ELECTROWELD TUBE MILLS

Mechanical tubing and standard weight pipe for the Automotive, Marine, Railroad, Home Appliance, Electrical, Furniture, Machinery, Petroleum, Food, Chemical, Construction and Other Industries.

A.E.F.

AMERICAN ELECTRIC FUSION CORPORATION

2618 DIVERSEY BLVD. • CHICAGO 47, ILLINOIS

Cable Address: AEFCORP, Chicago

Printed in U.S.A.

The Heart of the

a.e.f.

TUBE MILL

THE EXCLUSIVE A.E.F. WELDING UNIT WHICH WELDS A GIVEN THICKNESS WITH UP TO 50% LESS KVA DEMAND THAN ORDINARY TUBE WELDERS

Dependable A.E.F. Welding Units will produce perfect welding at lower operating cost than is possible with conventional tube welders. The A.E.F. patented design rotary transformer eliminates current-consuming long leads, operates at electrical efficiency of over 90%. The unique system of oil-cooling is another feature that makes possible 24-hour-per-day operation and eliminates entirely the danger of transformer failure. The Welding Unit is mounted on ball bearings and is rotated by the friction on the tube. It automatically adjusts itself to the speed of forming without any slippage.

For long, uninterrupted service, low power consumption, economy, efficiency, and above all, quality of weld, there is nothing else comparable. Take the first step toward cutting your tubing costs. Write for descriptive catalog.

1. 60 KVA LIGHT WALL MILL produces tubing with wall thickness from .025" to .093" and outside diameters from ¼" to 2½"; with slight modification at factory, limits can be extended to make tubing up to 3" O.D.

2. 170 KVA MEDIUM WALL MILL produces American standard weight pipe from ½" to 2", as well as mechanical tubing up to 4" O.D. with maximum wall thickness of .156".

3. A.E.F. HEAVY WALL MILL produces tubing up to 6" O.D. Detailed information on request.

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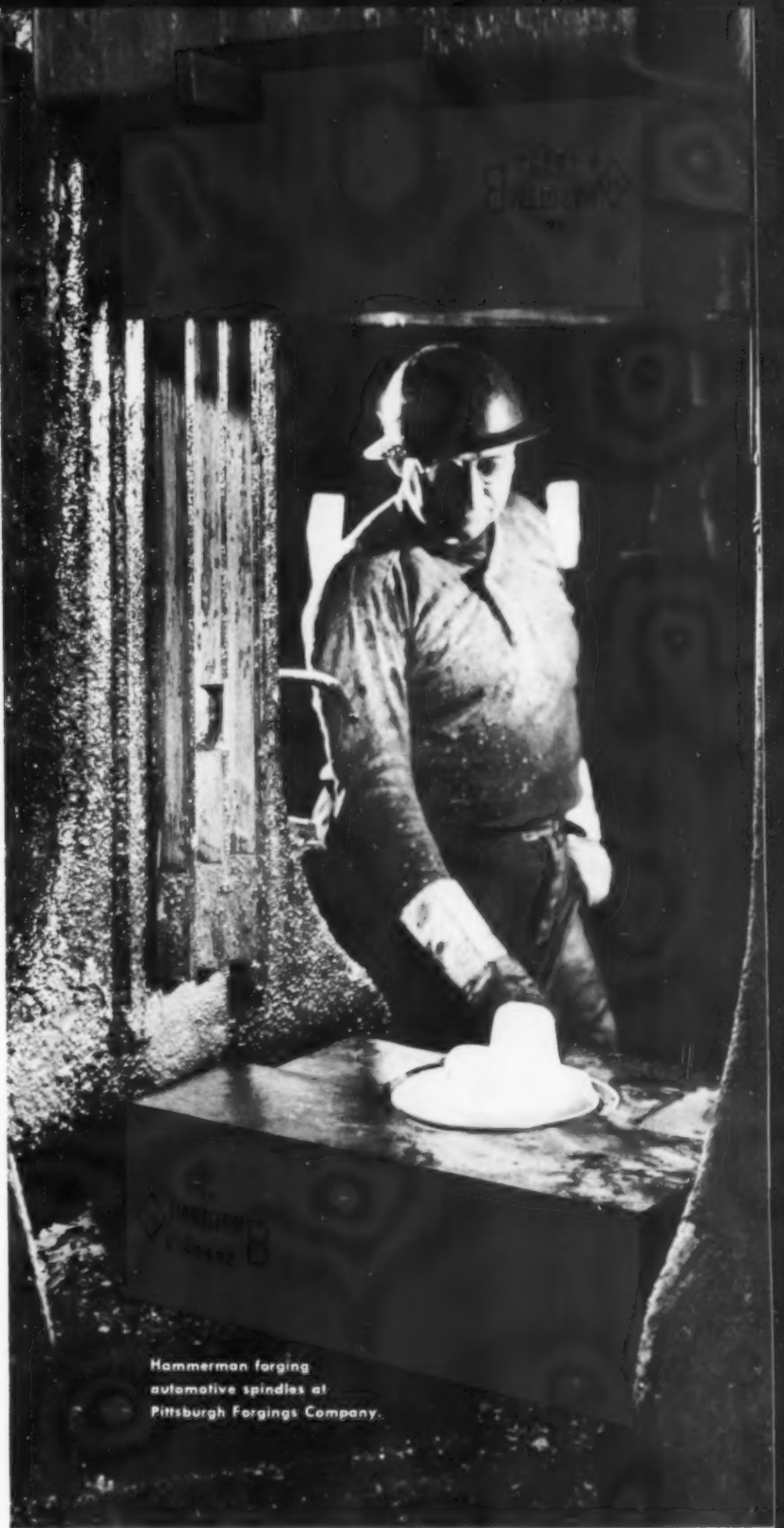
extra stamina under the hammer

Heppenstall die blocks



Hammerman forging automotive spindles at Pittsburgh Forgings Company.

Heppenstall Die Blocks are expected to give extra, better service—and rightly so. The Heppenstall steel used in them and the exclusive Hardtem process which they undergo, produce blocks which bring substantial advantages to the user.

In your plant, too, you can rely upon Heppenstall Die Blocks for more forgings per sinking, more forgings per block—resulting in greater production at lower cost.

60th ANNIVERSARY 1869 1949

HEPPENSTALL COMPANY

PITTSBURGH DETROIT BRIDGEPORT

AIRCOLITE — AIRCO SELF HARDENING — AIRCO TUNGTUBE — AIRCO TUNGSERTS — AIRCOLOY NOS. 1 & 6 — AIRCO NOS. 388, 91, 82, 53, 46 AND NICKEL MANGANESE

Special Offer

AIRCO'S NEW

HARDFACING ALLOYS

. . . a trial assortment for only $2.95

Your name on the coupon below will bring you — *at a special introductory price of only $2.95* — a trial assortment of Airco's NEW line of Hardfacing Alloys.

You will receive:

1. The NEW Aircolite Hardfacing Alloy (for oxyacetylene and electric application) — especially recommended for pulverizer hammer, coke crusher rolls, and so on, subjected to *severe abrasion and medium impact.*
2. The NEW Airco Electric Self Hardening Alloy — for bucket teeth, sizing screens and similar equipment subjected to *severe impact and abrasion.*
3. Instructions for these two alloys, plus a booklet describing Airco's line of Hardfacing Alloys.

. . . and of vital importance to you — you will receive enough of these rods to see for yourself how the NEW Airco Hardfacing Alloys extend the service life and improve the operating efficiency of your equipment.

Since this special price is good for a limited time only, we suggest that you fill in and mail the coupon below — NOW! Send it to our nearest office or authorized dealer. On West Coast: Air Reduction Pacific Company. Represented Internationally by Airco Corporation (International).

Mail this coupon today for your special assortment of the New Airco Hardfacing Alloys ▶

15
Air Reduction
60 East 42nd Street, New York 17, N. Y.

☐ Here is my check for $2.95 — send me the special package of Airco's Hardfacing Alloys.

☐ Send me your booklet: "Airco Hardfacing Alloys" — at NO cost to me.

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AIRCO **AIR REDUCTION**

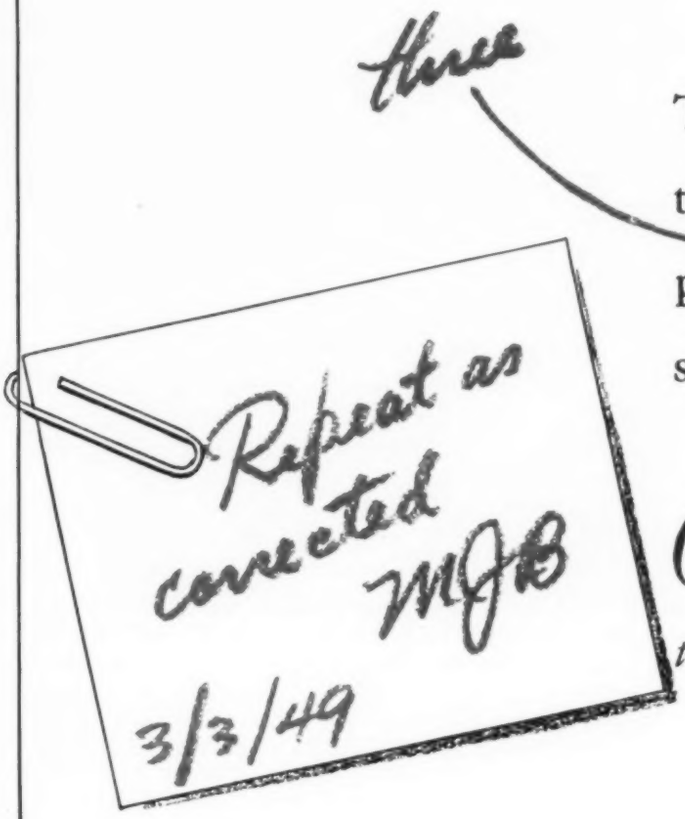
Offices in All Principal Cities

Headquarters for Oxygen, Acetylene and Other Gases... Carbide... Gas Welding and Cutting Machines, Apparatus and Supplies... Arc Welders, Electrodes and Accessories

Hagan

AIR OPERATED

SOAKING PIT CONTROLS



three

The first installation of these controls has completed ~~one~~ full years of satisfactory operation.

Our engineers will be glad to give you full information.

HAGAN CORPORATION

HAGAN BUILDING • PITTSBURGH 30, PA.

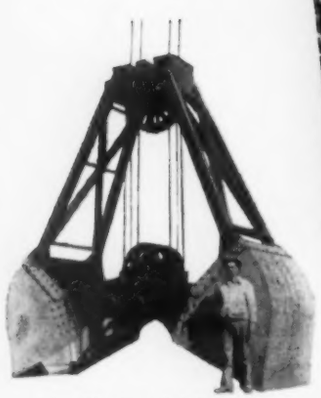
Wellman will build it

Special Cranes
Ore Bridges
Gas Producer Plants
Charging Machines
Industrial Furnaces
Car Dumpers
Gas Flue Systems
Gas Reversing Valves
Coke Pushers
Mine Hoists
Skip Hoists
Clamshell Buckets

Wellman Ore and Coal Handling Bridges

For fast and efficient action

One of two 6-ton Coal Handling Bridges in this installation.



6-ton Wellman Williams Type Coal Bucket used with these bridges.

• Take advantage of Wellman's long experience in designing and building handling bridges in many types and capacities. Your selection from the complete line will provide fast and efficient handling of coal or ore.

THE WELLMAN ENGINEERING COMPANY

7031 CENTRAL AVENUE • CLEVELAND 4, OHIO

PHOTO BY CHICAGO SUN-TIMES

At W. F. Hall Printing Company, Chicago, one of the world's largest printing plants, a fast, powerful, new Whitcomb 50-ton Diesel replaces an old "Iron Horse" which, because of its smoke, had been termed a nuisance by nearby home-owners.

A Whitcomb 65-ton Diesel delivers inbound cars of scrap, sand, lime, etc., to 100-acre plant of Scullin Steel Company, St. Louis, makers of steel castings. Whitcomb Locomotive is also used for charging open hearth furnaces here.

At Dravo Corporation's Neville Island, Pittsburgh, plant, a Whitcomb 20-ton Diesel Hydraulic locomotive spots a car for loading at a shipping dock. This Whitcomb locomotive handles all inbound and outbound freight for this important Dravo plant.

Whitcomb Industrial Diesels Cut Costs, Speed Work Throughout Industry

WHITCOMB DIESELS are the choice of important companies for important jobs throughout industry, whether it's hauling timber in an Idaho forest, or charging furnaces in a Pittsburgh steel mill. Wherever materials must be moved in volume, wherever heavy motive power is needed in production, Whitcomb Diesels recommend themselves through compact power, speed, high availability, low operating costs, low maintenance costs. So, follow the leaders and get the facts on Whitcomb Locomotives today. There is a Whitcomb locomotive for every requirement, Diesel electric or Diesel mechanical, in various sizes, gauges, and weights ranging from 3 to 95 tons.

Doing logging railroad duty for the Potlatch Forests, Inc., Lewiston, Idaho, this Whitcomb 65-ton Diesel electric climbs steep, mountainous grades in remote logging areas where before only steam geared locomotives could operate.

Whitcomb Locomotive pushes a charge of timbers into creosote cylinder at American Lumber & Treating Company's Everett, Washington plant.

At the new Noralyn phosphate mine near Bartow, Fla., a Whitcomb Diesel does 24-hour duty.

There is no power cheaper than Diesel; no locomotive finer than a Whitcomb locomotive.

THE BALDWIN GROUP

THE WHITCOMB LOCOMOTIVE CO.

ROCHELLE, ILLINOIS

Subsidiary of

THE BALDWIN LOCOMOTIVE WORKS

Speeding Production

SHEET AND TIN PLATE IN THE FAR WEST

10 FURNACES
30 BASES
in a single installation

SWINDELL-DRESSLER

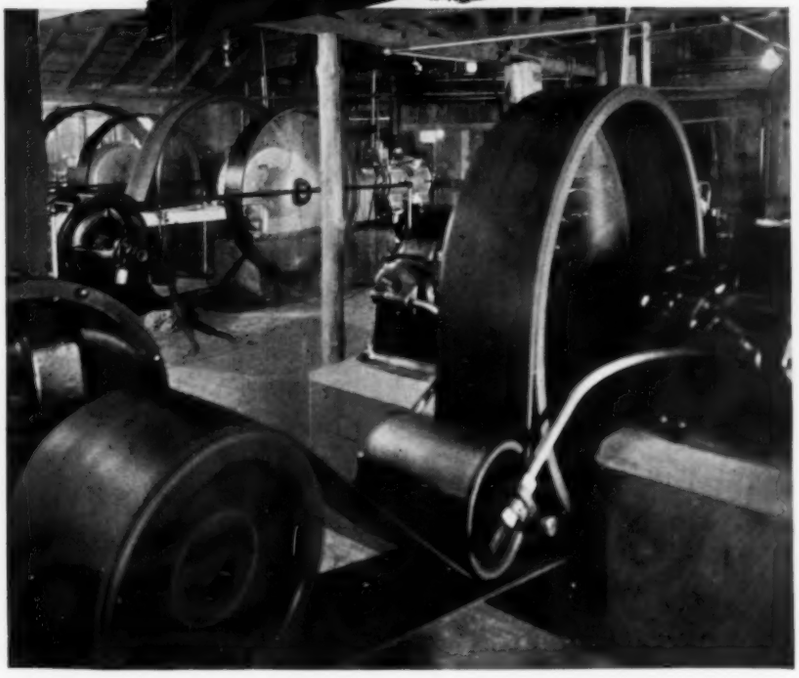
Recirculating

RADIANT TUBE
ANNEALING FURNACES

Ten Swindell-Dressler bell type annealing furnaces serve 30 bases in this recent installation—annealing cold-reduced steel in coils 56" O.D., piled four to a stack, eight stacks to a base. Each furnace employs 40 recirculating radiant combustion units, and measures 13'2" wide, 28'1" long, 13'9" high (interior). • *May we discuss an efficient solution to your own annealing problem?*

SWINDELL-DRESSLER Corporation
DESIGNERS AND BUILDERS OF MODERN INDUSTRIAL FURNACES
PITTSBURGH 30, PA.

CUT TOMORROW'S SHUTDOWNS, TODAY



Whenever wiring jobs come up, think beyond today's wiring needs—think in terms of cutting costly shutdowns—think in terms of maintenance-saving, time-saving Deltabeston* wires and cables. Make it a habit, wherever heat's a threat, to specify Deltabeston throughout, because Deltabeston wires and cables are made specifically to combat the effects of heat, moisture, and corrosive vapors; they give electrical systems protection from immediate hazards, and an extra margin of protection to cover future, unanticipated needs.

So whether you're rewiring an existing system or installing a system in new construction, don't overlook heat-beating Deltabeston. The Deltabeston line includes standards and "specials" for every combination of heat, moisture, corrosive vapor, or other conditions—for temperatures up to 200 C. It gives the system extra protection both on hot jobs and on ordinary installations. And, men who know your problems stand back of your Deltabeston supply source ready to advise you on selection.

For full information on Deltabeston, write to Section Y26-346, Construction Materials Department, General Electric Company, Bridgeport 2, Connecticut.

*TRADE-MARK REG. U. S. PAT. OFF.

GENERAL ELECTRIC

HI-AMBIENTS

Application hints on the complete Deltabeston line

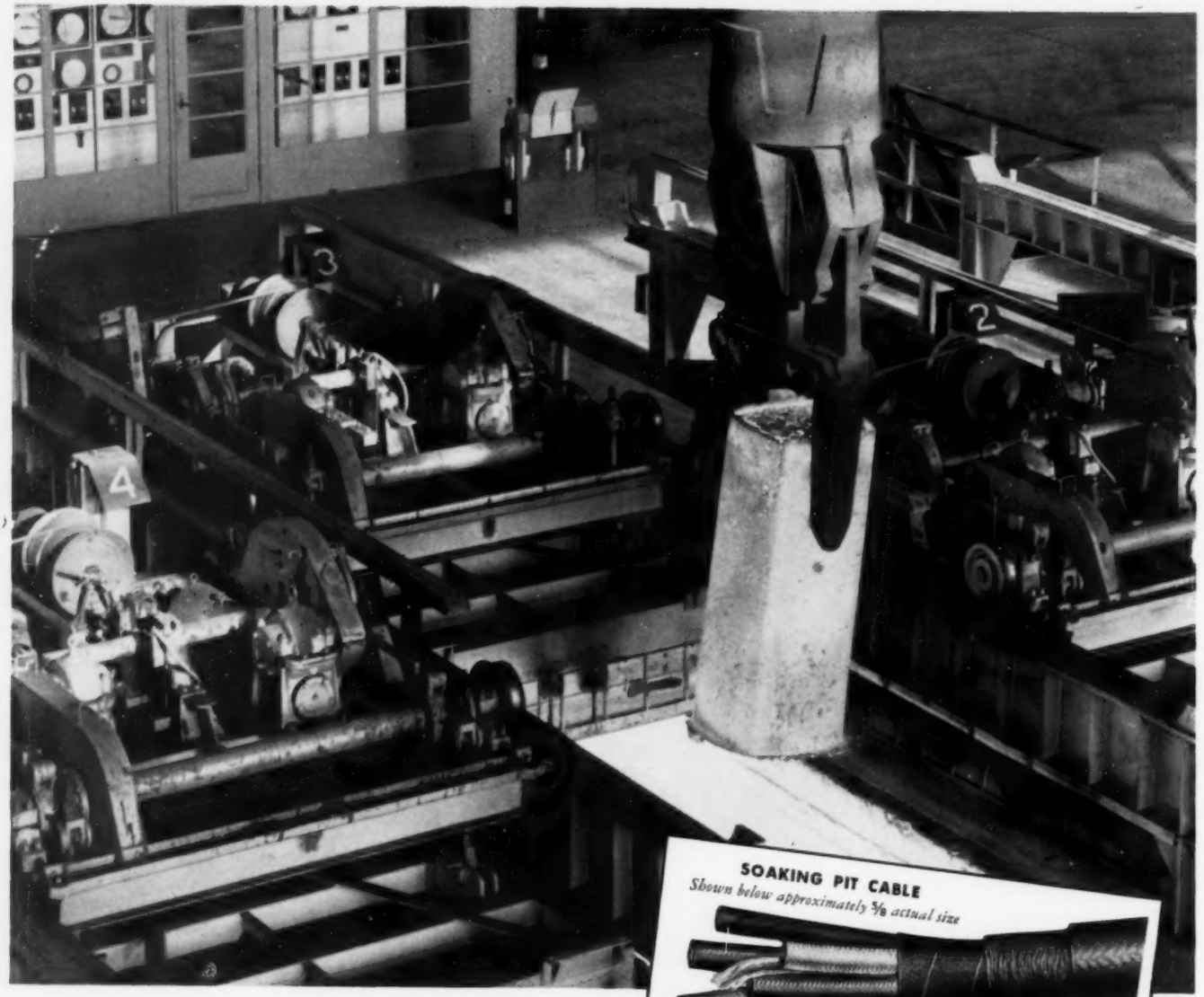
FLEXIBLE HINGE CABLE for swinging panel connections and general switchboard work is available in the Deltabeston Switchboard Wire and Bus Cable line. Insulated with felted asbestos and covered with cotton braid with flame-resistant finish, it is essential for wiring switchboards up to 90 C (194 F).

SPREADING OUT. Originally designed for infrared oven use, silicone-treated Deltabeston cables proved so successful that now they're being used for both 300- and 600-volt service on many extra-high heat applications. On jobs where the temperature goes as high as 200 C (392 F), specify silicone-treated Deltabeston.

MOISTURE RESISTANCE is only one of many advantages Deltabeston power cable offers you. Like all Deltabeston products, it's a heat beater because it's insulated with purified asbestos. Varnished cambric and heavy braid or lead sheath help resist abrasion, flame, grease, corrosive vapors, and oil.

SIMPLIFIES SELECTION. To help in the selection of the proper Deltabeston magnet wires for the jobs you've got to do, General Electric has prepared the *Deltabeston Magnet Wire Booklet*. This handy guide contains facts on the many kinds of magnet wire made by General Electric, and includes a handy specification chart to make selection easy. For your free copy, write to Section Y26-346, Construction Materials Department, General Electric Company, Bridgeport 2, Connecticut.

DELTABESTON
Wires and Cables
Built to beat the heat



This cable "tortures" itself to do its job

Soaking pits are usually set up in groups of three or more. Mechanisms and actuating cable for each are mounted directly over the pit cover on a movable carriage. When the cover slides open, carriage, mechanism and door are moved back along a trackway leaving the pit opening entirely clear.

When one pit is open, the apparatus on either side is subjected to blasting heat. Soaking pit temperatures reach 2000° for sustained periods. Cable to do this job must be able to withstand the "torture" without failing.

ROCKBESTOS PRODUCTS CORP., NEW HAVEN 4, CONN.

NEW YORK CLEVELAND DETROIT CHICAGO PITTSBURGH
ST. LOUIS LOS ANGELES OAKLAND, CALIF.

SOAKING PIT CABLE

Shown below approximately ⅝ actual size

1 Tinned copper conductors perfectly and permanently centered in helically applied insulation.
2 Heatproof, fireproof felted asbestos that will not ignite or burn.
3 Varnished cambric for high dielectric strength and moisture resistance.
4 Another felted asbestos wall to seal the varnished cambric away from heat, flame and oxidization.
5 Color-coded cotton braid for easy circuit identification.
6 A wrapping of moisture-proof tape to bind the cabled conductors.
7 A heavy wall of heat, flame and moisture resistant felted asbestos to protect the assembly from external heat and flame.
8 A tough, rugged asbestos braid impregnated with inert compounds that are resistant to heat, flame, moisture, oil, grease and corrosive fumes.

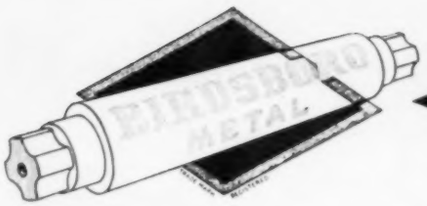
The cutaway drawing shows how ROCKBESTOS construction enables this cable to meet the severe requirements of soaking pit installation.

Write for further information.

WIRES and CABLES by

ROCKBESTOS

. . . . *dare* to be better



CUROLOY

BIRDSBORO

COPPER BEARING ROLLS

(PATENTED)

Birdsboro Rolls are individually designed and engineered to meet your specific needs for hot rolling (without water) of super high grade alloy, tool, non-corrosive, and heat resisting steels.

Birdsboro Rolls come in these "exclusive" types . . .

"Birdsboro 30" Alloy Steel Rolls
"Birdsboro 40" Alloy Steel Rolls
"Birdsboro 50" Alloy Steel Rolls
"Birdsboro Metal" Alloy Iron Rolls
Birdsboro "Curoloy" Alloy Iron Rolls

. . . for every step in the process of hot rolling from ingot to finished bar; blooming, roughing, intermediate, leading, and finishing.

For longer roll life, greater tonnages and more rolling accuracy, specify BIRDSBORO ROLLS.

BIRDSBORO ROLLS

BIRDSBORO ROLLS

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Birdsboro Steel Foundry & Machine Co. • Birdsboro, Pa.

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Rolls • Crushing Machinery • Steel Mill Equipment • Hydraulic Presses • Steel Castings • Special Machinery

A CLUE TO LIFETIME CABLE VALUE

Look for this ridge and you find a reason . . .

It's the mark of an Okonite cable, proof that highest quality insulation has been applied to the conductor by Okonite's strip process. Still prominent after removal of the continuous metal vulcanizing mold, this ridge symbolizes many extra engineering features built-in to make sure Okonite outperforms ordinary cables . . . offers true economy in these days of high installation costs.

HERE, FOR EXAMPLE, IS A CABLE THAT'S PROTECTED 4 WAYS

It is a cable with a long and extensive service record. It is an Okolite-Okoprene cable with extra protection from conductor coating to sheath. It passes, in addition to a-c tests, high voltage d-c tests more severe than those required by any other manufacturer.

Into four different parts of this cable, extra service life is built . . . *at the conductor* (1) by a coating of Okoloy, a special corrosion-resistant lead alloy that outlasts tinning 2 to 1 . . . *about the conductor* (2) where an application of Semicon tape — on all Okolite-Okoprene cables operating at over 2000 volts — eliminates internal corona cutting and increases dielectric strength.

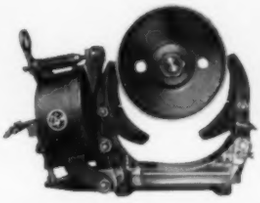
True cable value is added *by the insulation* (3) which is moisture-resisting, high-voltage Okolite made with Up-River Fine Para Rubber, the best grade of natural rubber. Okolite, an oil base insulation, has been proved in over 20 years of service, and is approved by Underwriters' Laboratories, Inc. as Type RWSN. *The outer sheath* (4) is Okoprene, the pioneer neoprene cable covering developed in the Okonite laboratories. Its life-extending durability and stable characteristics have been demonstrated on millions of feet of cable installed during the last 14 years.

Okolite-Okoprene cables possess many advantages from the standpoints of installation, electrical operation and design. These, along with dimensions and other data, are combined in an illustrated Bulletin IS-1037. For a copy, address The Okonite Company, Passaic, New Jersey.

THE BEST CABLE IS YOUR BEST POLICY

OKONITE OKONITE SINCE 1878 *insulated wires and cables*

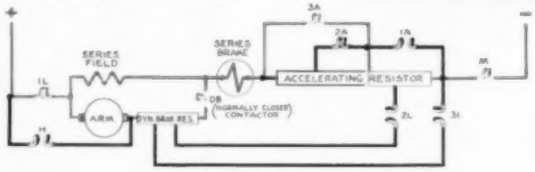
Complete Control for Cranes



LONG-LIFE Brakes give high speed performance—with low up-keep.

TIME - CURRENT Relay matches acceleration to the d-c load.

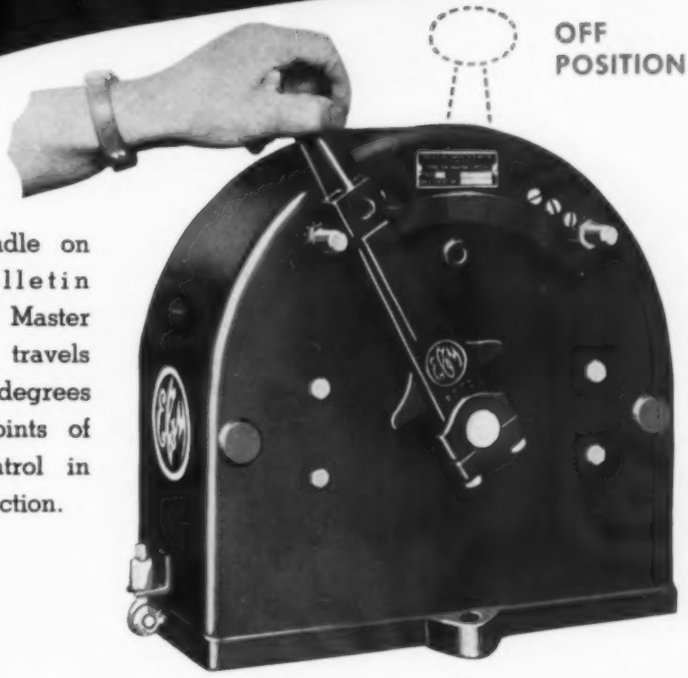
YOUNGSTOWN Safety Limit Stop—a positive check against human error.



SIMPLIFIED, Safe Dynamic Lowering Hoist Control.

First point lowering connections with the EC&M Wright Circuit.

Short-Throw Master Switches are easy on Crane Operators

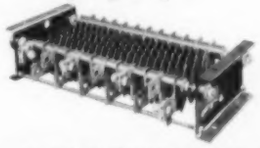


The handle on EC&M Bulletin 1190 Cam Master Switches travels only 37½ degrees for six points of speed control in either direction.

Look at the small throw on the EC&M Cam Master Switch. Only these switches use large (7-inch diameter) cams which give the operator a number of speed points in a short movement of the handle. For magnetic control applications, specify EC&M Bulletin 1190 Cam Master Switches.

Narrow Width permits close grouping. Shown at the left are three masters with handles on 9-inch centers. Several of these switches can be reached from one operating point.

TAB-WELD Resistors—no burning where burning would cause high up-keep.



CRANE DISCONNECT SWITCH Manual-magnetic for ease of operation.

THE ELECTRIC CONTROLLER & MFG. CO.

2698 EAST 79TH STREET ★ CLEVELAND 4, OHIO

NO. 1 First of two advertisements describing Allis-Chalmers equipment for ore beneficiation.

ALLIS-CHALMERS

Low Grade

With Steel Mills Operating at 100% Capacity, Iron Ore Producers are Looking to Beneficiation of Low Grades To Beat Shrinking Ore Supplies. Allis-Chalmers, One of The World's Largest Manufacturers of Ore Reduction Machinery, Furnishes Basic and Auxiliary Equipment for Ore Concentration Plants.

MANY OF THE IRON ORE PREPARATION plants already in operation use Allis-Chalmers equipment to increase production. As three tons of low-grade ores have to be processed to produce one ton of concentrate, producers must step up the scale of mining to make low grades pay off. And that's where Allis-Chalmers can help.

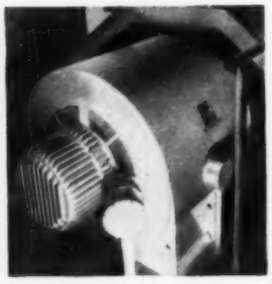
Specialized Allis-Chalmers engineers have studied ore beneficiation methods and equipment from a cost-cutting, tonnage increasing point of view. These specialists guide in the selection of your equipment and help develop new, improved processing equipment.

FOR TOP CRUSHING EFFICIENCY, ore producers are using Allis-Chalmers primary, secondary and tertiary crushers. The Superior McCulley crusher, shown above, is used for tough, abrasive, high compressive materials. This type of crusher is now used for crushing taconite.

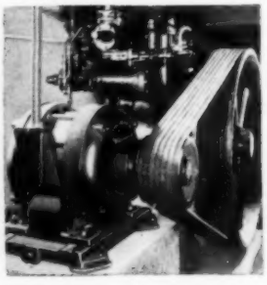
In addition to gyratory type crushers, Allis-Chalmers manufactures a complete line of reduction crushers, jaw crushers, crushing rolls and hammer mills. This means the operator can pick the exact crusher for a particular job, without limitation to size of application.

A-C solids handling pumps were specially designed for simple maintenance. Construction is of abrasive-resistant material adapted to metal mining and process industries.

Motors for main and auxiliary drives, generators and control equipment are supplied by Allis-Chalmers. Sizes range from one horsepower for both a-c or d-c service.



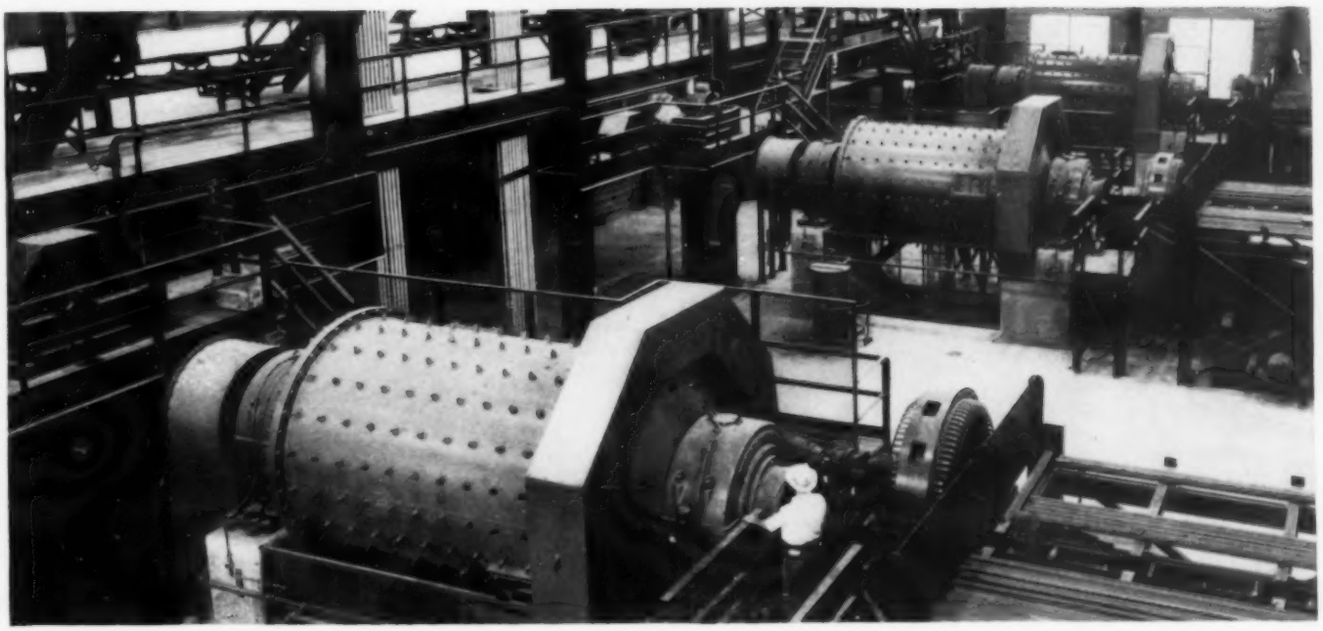
Texrope drives are shock-absorbing, compact and economical. Allis-Chalmers, originator of multiple V-belt drives, offers engineering advice with unparalleled drive experience.



Power, Electrical, Processing Equipment for Iron and Steel

ALLIS-

BUILDS EQUIPMENT TO MAKE
Ores Pay Off

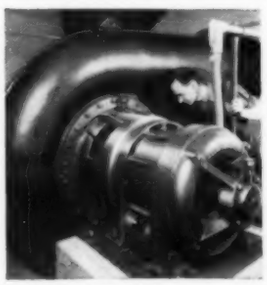


ROD MILLS ARE ONE OF FIVE separate types of grinding mills built by Allis-Chalmers. The three 8′ x 12′ A-C rod mills shown above are an outstanding installation in the Adirondack iron development. A-C builds grinding mills of the rod and ball types in sizes from 3′ to 10½′ diameter, 3′ to 16′ lengths.

Metallurgical, mining and chemical engineers have worked together at Allis-Chalmers to develop mills for any grinding problem. Only Allis-Chalmers manufactures all the related equipment to power and control this ore reduction machinery. Operators get a completely co-ordinated installation with undivided Allis-Chalmers responsibility.

IT IS IMPORTANT that you consider future processing equipment needs NOW. An Allis-Chalmers representative can tell you more about the complete line of ore beneficiation equipment. Call Allis-Chalmers district office or write direct.

A-C builds turbo-blowers for converter or furnace blowing and ore flotation. Blowers are supplied in capacities up to 130,000 cfm at pressures from 1 to 35 lb G.



A-1 and *Texrope* are Allis-Chalmers Trademarks.

NO. 2 ALLIS-CHALMERS BUILDS EQUIPM

Low Grade Ores P

The second advertisement describing Allis-Chalmers equipment for ore beneficiation will be published next month. Send coupon below for reprints of the two advertisements.

ALLIS-CHALMERS, 1020A SO. 70 ST.
MILWAUKEE, WIS.

Please send advertisement reprints on Allis-Chalmers ore beneficiation equipment.

Name

Title

Company

Address A 2605

ALLIS-CHALMERS A-C MILWAUKEE

CHALMERS

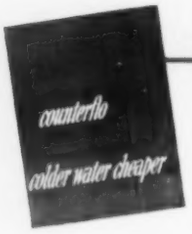
every FLUOR counterflo cooling tower delivers colder water cheaper

* **colder**
Fluor towers give closest wet-bulb approach

* **cheaper**
Fluor towers cost less per degree of cooling

Five 30 x 30 cell coilshed cooling tower of the Counterflo induced-draft type, built by Fluor for a large gas-gasoline plant. *Guarantee:* 98° to 78° cooling at 73° wet bulb. *Performance:* as guaranteed. Photo by Elwood M. Payne.

Every Fluor *Counterflo* cooling tower cools to the guaranteed temperature! Does this *insured performance* cost you more? No! Fluor towers are prefabricated in standard cell sizes for low erection costs—and engineered to give maximum cooling per fan horsepower.



SAVE YOUR COMPANY MONEY

Before buying a cooling tower, we urge you to look at the engineering *facts* presented in the new booklet "Colder Water Cheaper." Write us for your copy.

BE SURE ft WITH FLUOR

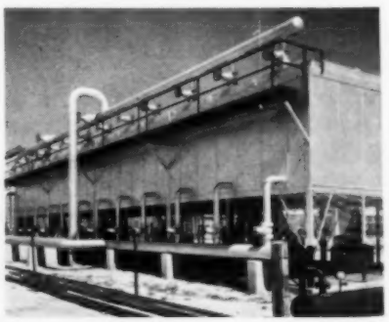
FLUOR

THE FLUOR CORPORATION, LTD.

Los Angeles 22 • NEW YORK • PITTSBURGH • HOUSTON
KANSAS CITY • BOSTON • TULSA • SAN FRANCISCO

492

Fin-Fan Units

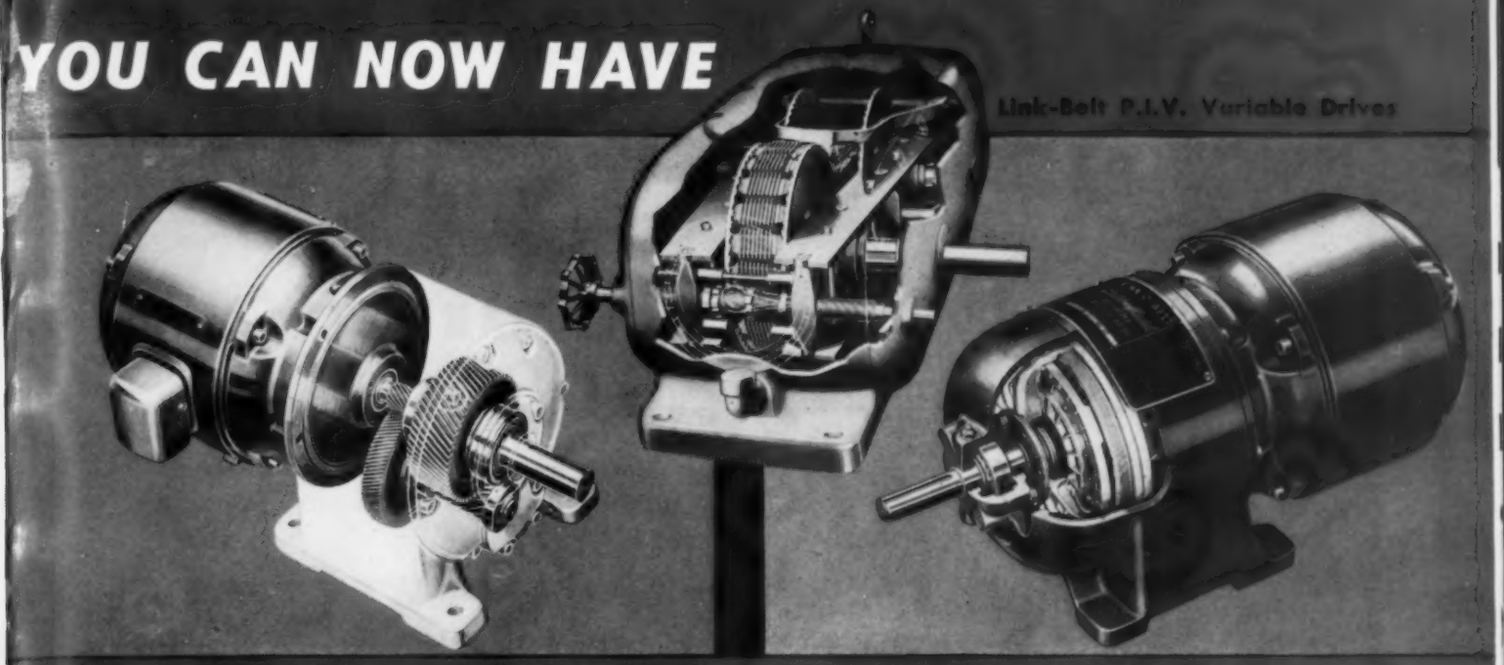


Fluor air-cooled heat exchangers are more economical where make-up water is expensive, where water has bad scaling characteristics, and where the temperature of liquid to be cooled is relatively high. (Manufactured and sold by Fluor and by Griscom-Russell Co.)

Pulsation Dampeners

Fluor pulsation dampeners remove destructive vibrations and instrument irregularities caused by pulsative gas flow.

YOU CAN NOW HAVE

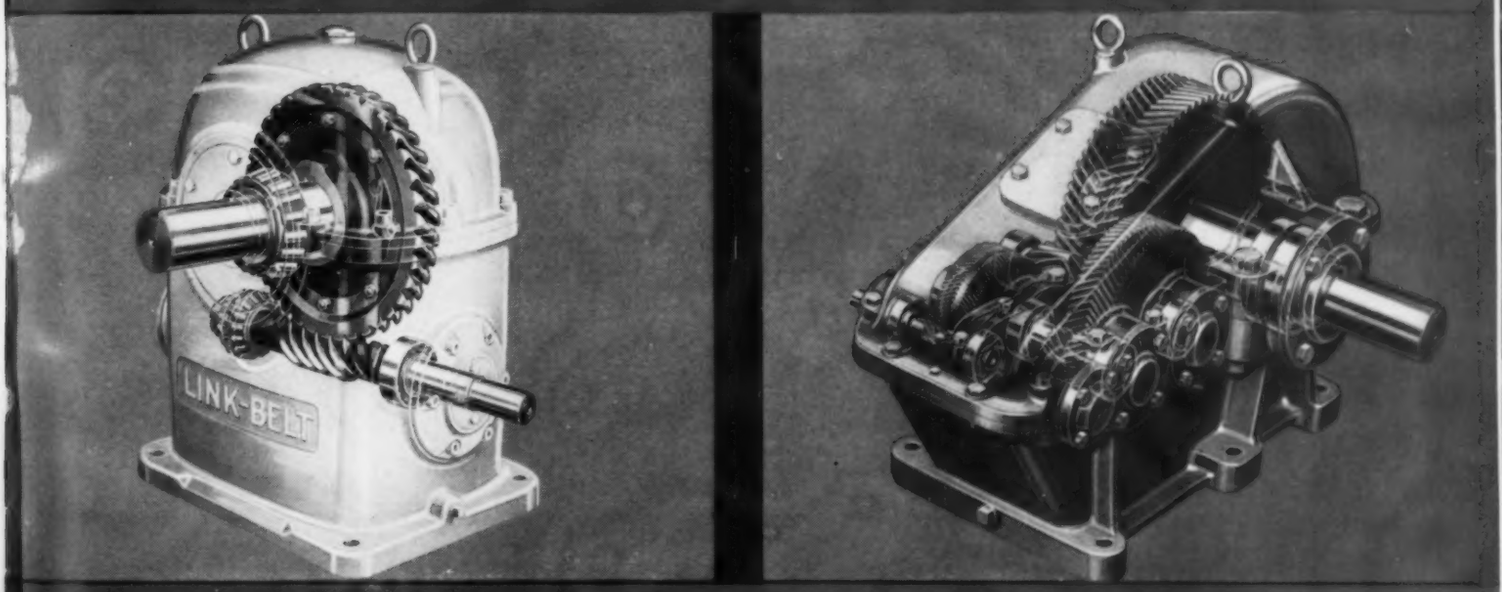


Link-Belt P.I.V. Variable Drives

Link-Belt Gearmotors

Link-Belt Electrofluid Drives

IMMEDIATE DELIVERY ON



Link-Belt Worm Gear Drives

Link-Belt Herringbone Gear Drives

LINK-BELT ENCLOSED DRIVES

YOU can push production by using dependable, efficient Link-Belt Drives. The added efficiency of the proper drives for speed reduction, speed variation or other power transmission is available to you *at once*. Because Link-Belt manufactures a complete line, you can rely upon the unbiased advice of a Link-Belt Engineer as to the proper drive for your particular need. For prompt and reliable service, please call our nearest office.

LINK-BELT COMPANY Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices, Factory Branch Stores and Distributors in Principal Cities.

11,418

LINK-BELT

Power Transmission Machinery

"THE COMPLETE LINE"

IT WON'T BREAK
if it's a new
O.Z.
ALL-BAKELITE BUSHING!

BOUNCE IT

Bounce an O. Z. All-Bakelite Insulating Bushing hard, on a concrete floor — it rebounds good as new. Add to its superior strength* these extra features and you've got a bushing that's best by any test!

- **Smooth rounded edges completely protect wire insulation during pulling and when in service.**
- **Clean, deep threads let you spin-on the bushing with a twist of the wrist.**
- **Ribbed outer surface provides a grip for slippery hands and permits tapping with a screw-driver.**

O. Z.'s New All-Bakelite Insulating Bushings are fully approved by Underwriters' Laboratories, meet all requirements of the National Electric Code.

Try a few, bounce 'em, treat 'em rough and you'll be convinced there are no all-Bakelite bushings better suited to the job . . . none so economical to use as O. Z.'s.

Available in sizes from ½ inch to 6 inches, cost no more than ordinary Bakelite bushings. Samples on request.

*56% stronger over all than all other leading all-Bakelite bushings actually tested by an independent laboratory.

CONDUIT FITTINGS • CABLE TERMINATORS
CAST IRON BOXES • GROUNDING DEVICES
SOLDERLESS CONNECTORS • POWER CONNECTORS

Buy O. Z. and you'll see why Engineers say, "They're OK if they're O.Z."

O.Z. ELECTRICAL MANUFACTURING COMPANY, INC.
262 BOND STREET · BROOKLYN 2, N. Y.

4899

PARALLOY

REGISTERED TRADEMARK

PINCH ROLLS
COILER ROLLS
TENSION ROLLS
STEEL MILL ROLLS

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HYDRAULIC SLAB AND BILLET PILERS

STRIP AND SHEET OILING EQUIPMENT

SHEET SCRUBBER AND CLEANING LINES

HOT SAWS — ROCKING AND SLIDE TYPES

HOT BEDS — COOLING BEDS — TRANSFERS

BILLET EJECTORS — PINCH ROLL STANDS

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STRIP STEEL COILERS AND REELS — SCRAP BALLERS

RAILROAD SPIKE FORMING MACHINES — ROLL LATHES

SHEET GALVANIZING LINES — WIRE PATENTING FRAMES

STRETCHER LEVELLERS — ANGLE AND SHAPE STRAIGHTENERS

ROLLING MILL TABLES — GEAR AND INDIVIDUAL MOTOR TYPES

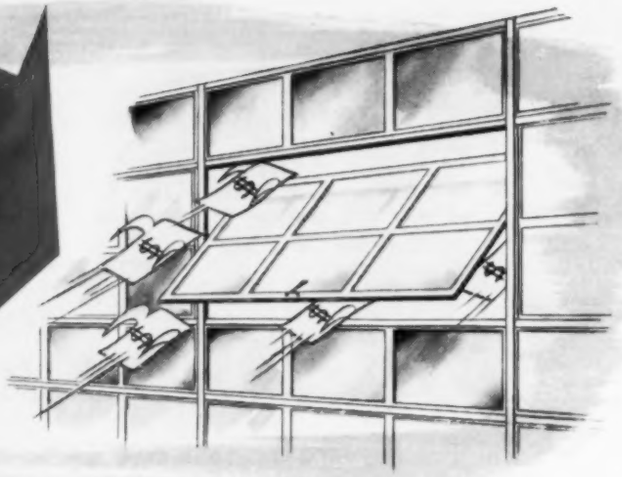
MACHINERY BUILT TO CUSTOMER'S

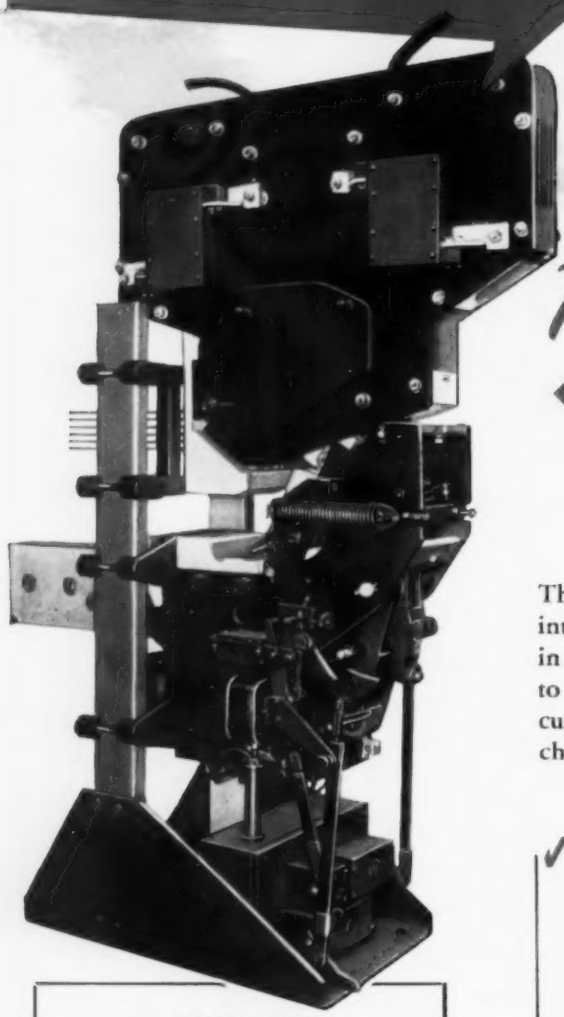
DESIGN AND DETAIL DRAWINGS

The Youngstown Foundry & Machine Co.

YOUNGSTOWN, OHIO

How much would a shut-down cost you?





Protect Production

with this better-designed, better-built breaker

Efficient production is a complete chain of operation. Obsolete electrical switchgear may be the weak link that can shut down your plant. Protect your production more effectively, more dependably, with I-T-E's Type MT Automatic Reclosing Circuit Breaker.

The MT is a rugged, effective breaker, specially developed for interrupting extremely heavy direct-currents. It breaks a circuit in .028 seconds (about 1¾ cycles on a 60-cycle basis) at 25% to 100% of interrupting capacity. Short circuits and overcurrents are cleared instantly, completely—before they have a chance to spread trouble.

TYPE MT

Single pole . . . Electrically operated . . . Application Ranges: 250 and 750 V. D-C. Interrupting rating is 150,000 Amp. in capacities of 2000 and 4000 continuous ampere ratings . . . 250,000 Amp. in capacities 6000 Amps. continuous and above.

Further information on the I-T-E Type MT is contained in catalog 2202. Send for it today.

NOTE THESE MT FEATURES

✓ **RATE-OF-CURRENT-RISE TRIP**

Anticipates extremely high currents . . . Distinguishes between useful load of high value and a dangerous fault current . . . Trips breaker before danger peak is reached.

✓ **TRIPPING DEVICES**

The MT is electrically and mechanically trip-free on overcurrent—trips immediately when closed on a fault . . . All tripping devices are direct-acting and instantaneous.

✓ **BUFFER MECHANISM**

A specially designed, self-energizing buffer mechanism smoothly absorbs shocks of opening—prevents sticking or bouncing.

✓ **MOUNTINGS**

Normally built in two styles: for pedestal mounting and for panel mounting. Also drawout-truck mounted in metal-clad switchgear.

The I-T-E Representative in your locality will be glad to advise you on applying the MT—and other I-T-E protective equipment—to your electrical distribution system. Use his services without obligation.

R&IE I-T-E

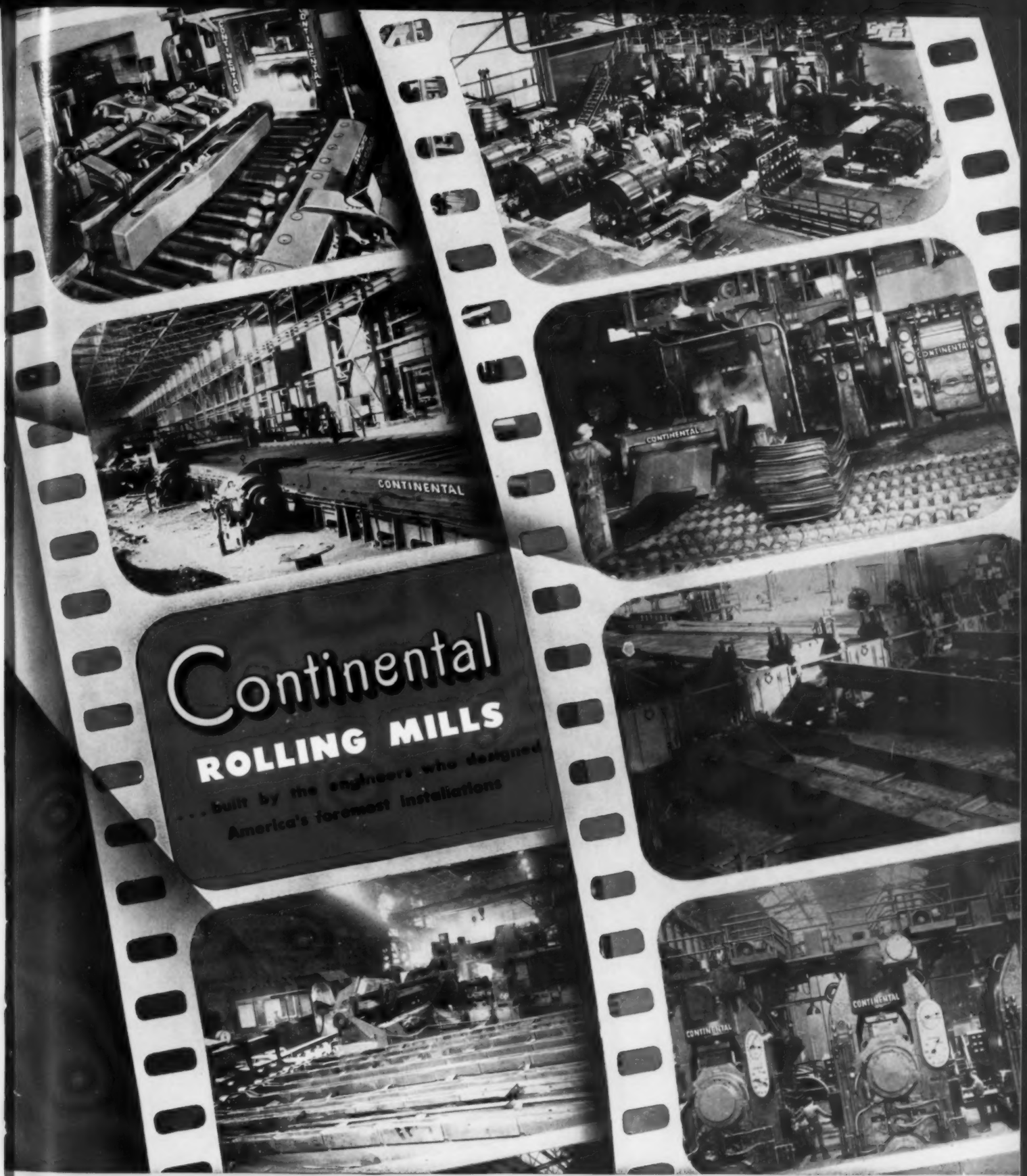
MILL TYPE SWITCHGEAR

The Leader In Technical Excellence

I-T-E CIRCUIT BREAKER CO. — 19th & HAMILTON STS., PHILA. 30, PA. — 31 OFFICES IN THE U. S. & CANADA

SWITCHGEAR • UNIT SUBSTATIONS • ISOLATED PHASE BUS STRUCTURES • AUTOMATIC RECLOSING CIRCUIT BREAKERS • HIGH SPEED CIRCUIT BREAKERS

**FOR POWER SWITCHING EQUIPMENT REFER TO RAILWAY AND INDUSTRIAL ENGINEERING CO. AN I-T-E SUBSIDIARY*

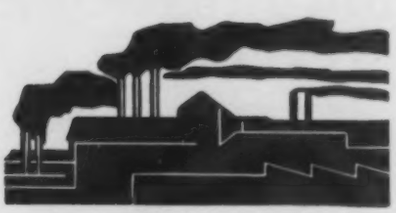


Continental

FOUNDRY & MACHINE CO.

CHICAGO · PITTSBURGH

Plants at East Chicago, Ind., Wheeling, W. Va., Pittsburgh, Pa.



Industry's Headquarters for
Carbon and Alloy Steel Castings
Rolling Mills and Equipment
Iron and Steel Rolls

Why Do Carborized Tubular Rollers Reduce Maintenance and Man Hours?

1. The finished tubes, less shafts, after finishing are deeply **carburized** in special deep cylindrical furnaces. Carefully metered gases are used and anhydrous ammonia is added giving a nitrided surface.

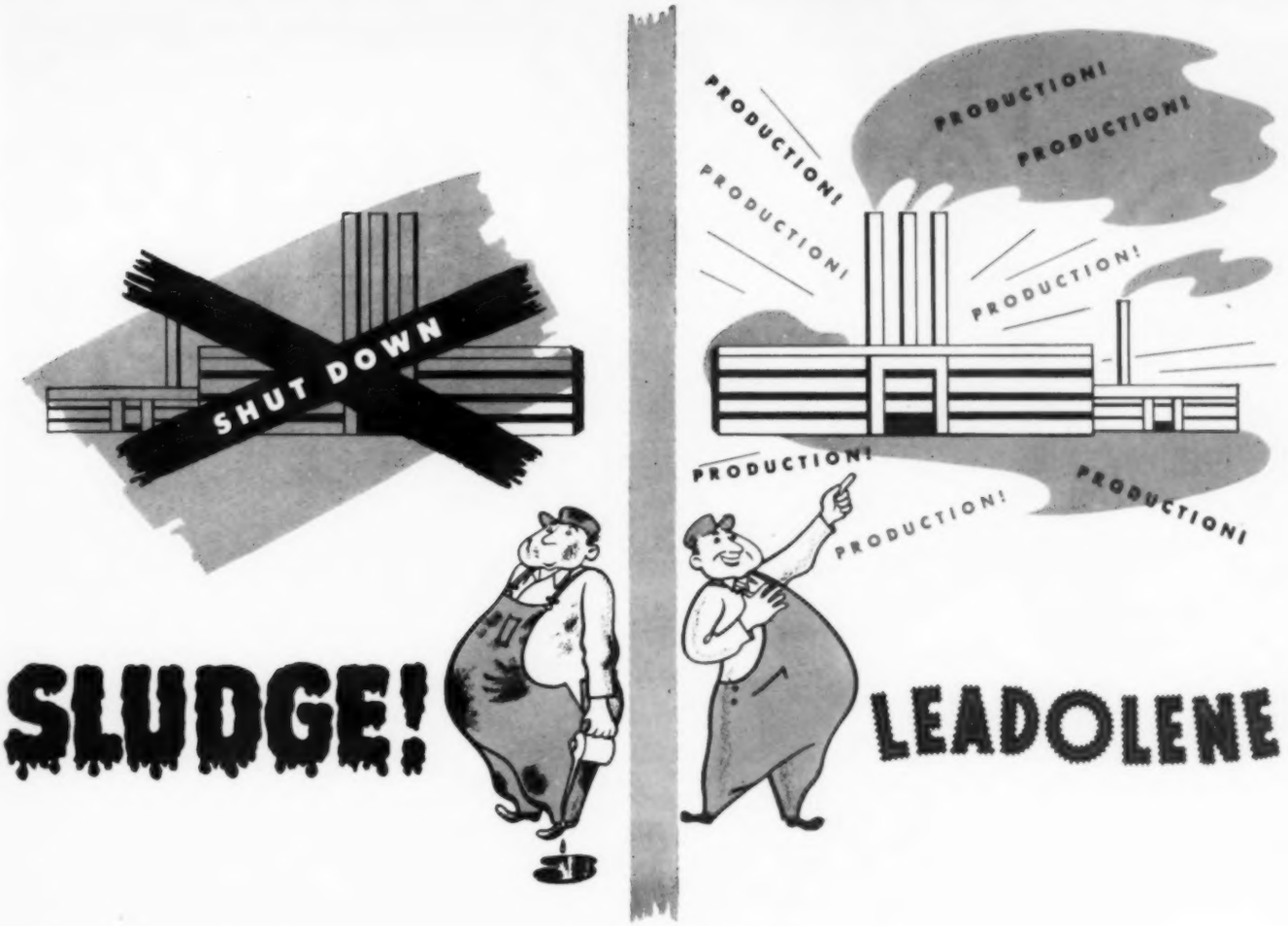
2. After carburizing for a definite number of hours, depending on the depth of case desired, the tubes are **quenched vertically** in refrigerated tanks. Due to the cylindrical structure quenching is so complete that no drawback can occur as so often happens with solid rollers.

3. The result is a surface hardness of 68 to 70 Rockwell "C" or 98 to 103 Scleroscope. This surface hardness is only exceeded by carborundum and the diamond.

THAT IS WHY this roll is still in service after 13 years faultless service.

BADALL ENGINEERING & MANUFACTURING COMPANY

239 DOUGLAS STREET HAMMOND, INDIANA



RECORDS SHOW *NO SLUDGING IN FIFTEEN YEARS* WITH

BROOKS LEADOLENE

Sludging—that's the quick, easy way to give any mill man gray hairs. And at the first sign of sludging, take a look at your pinions and gears. You'll see signs of pitting, cutting and excess wear. At this point you will need the skill and experience of the Brooks engineer. He will show you how "LEADOLENE", with its "Indestructible pH-ilm" will stop this excessive wear, pitting and sludging. As a matter of fact, in many instances you can continue using these damaged gears and pinions for years without replacing.

"LEADOLENE" always stays neutral—never becomes acid. Being unaffected by water, wear or sludging—make-up costs are negligible. Keep your mill at top production—change to "LEADOLENE" NOW!

The Brooks Oil Co.

**LEADOLENE . . . the "I.P. Lubricant" ("Indestructible pH-ilm) . . . for Industrial Needs*

Pittsburgh 12, Pennsylvania
Cleveland, Ohio
Hamilton, Ontario

Warehouses: In Principal Industrial Cities

LESS COST
PER TON OF STEEL ROLLED

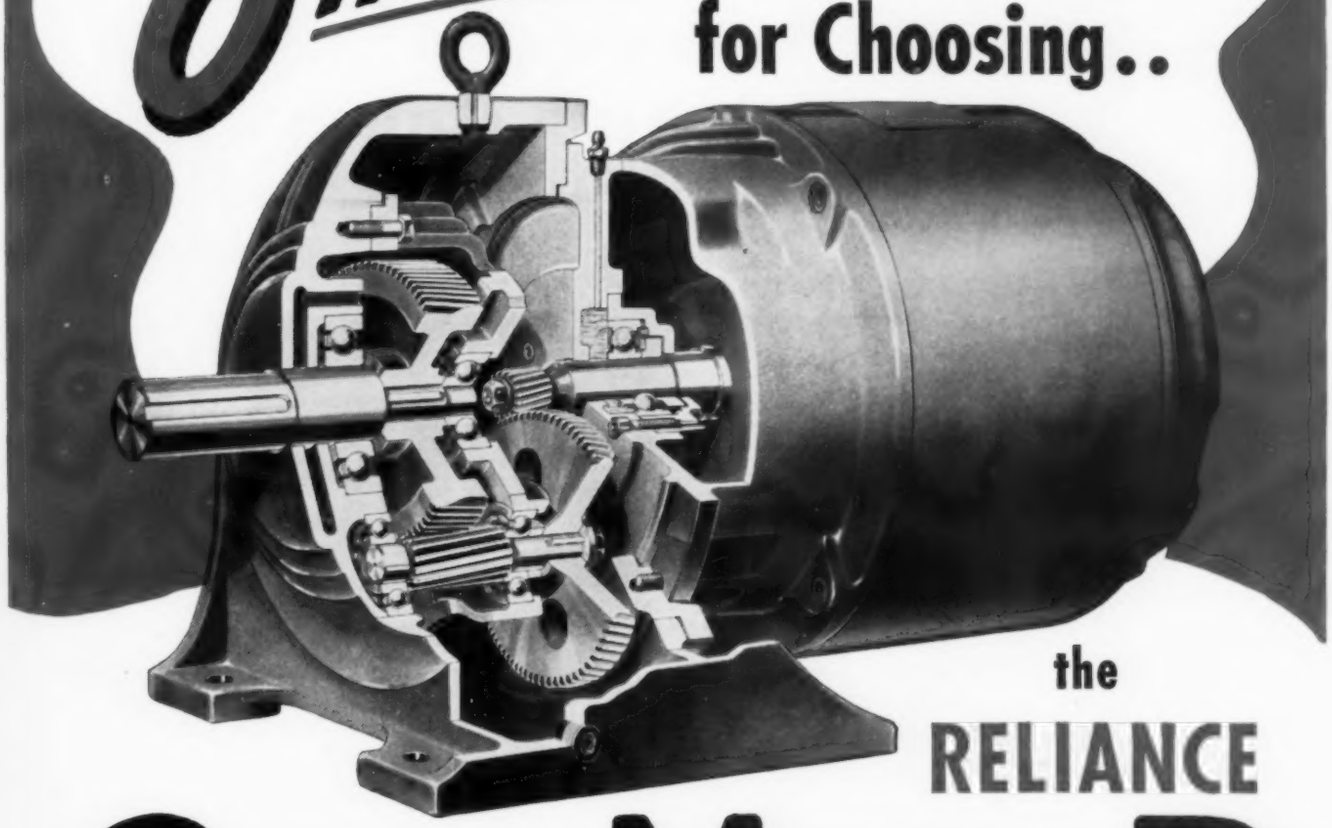
The rolling of merchant bars to meet present-day specifications as to size and finish, together with the ever-increasing demand for higher alloyed steels, requires rolls that are in keeping with the most modern technology as to composition and manufacture.

Pittsburgh Rolls makes the proper type rolls for each stand of the bar mill. These rolls, wherever used, represent all the skill and metallurgical knowledge that long experience and up-to-the-minute study can impart. The result—*less cost per ton of bars rolled.*

PITTSBURGH ROLLS

DIVISION OF BLAW-KNOX COMPANY, PITTSBURGH 1, PA.

6 INSIDE REASONS for Choosing..



the RELIANCE

GEARMOTOR

1 Helical, wear-hardened gears cut from alloy steel forgings and shaved before hardening for correct eccentricity and helical angle and bright, smooth surfaces—factors contributing to quiet operation and longer life.

2 Gear arrangement in simple train minimizes number of moving parts—promotes quietness.

3 Pinion and gear supported and spaced to reduce deflection—permits high load-carrying capacity.

4 Splash system with large oil reservoir assures constant and thorough lubrication of all parts.

5 Anti-friction bearing construction throughout.

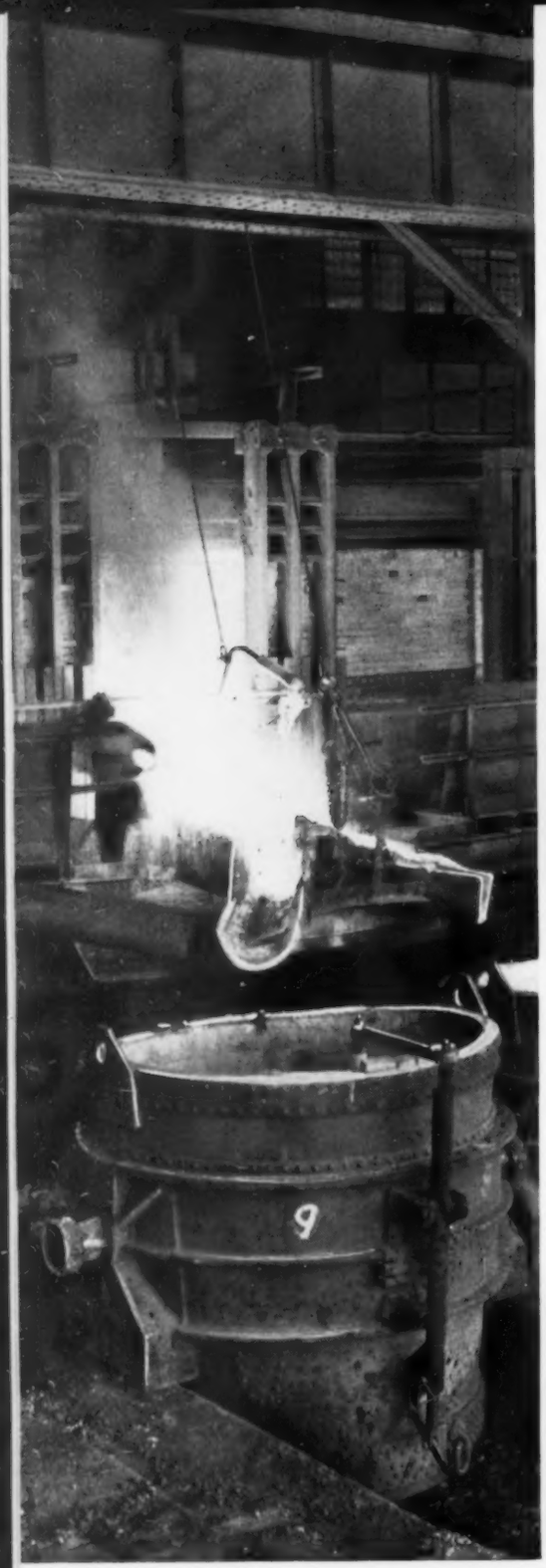
6 Reliance *Precision-Built* Motors provide the maximum in dependable and economical power. Types that may be had with GearMotoR are described in GearMotoR Bulletin C-404. Ask also for bulletins describing Reliance *Precision-Built* A-c. Motors—engineered for every power requirement.

Sales Representatives in Principal Cities

RELIANCE ELECTRIC AND ENGINEERING CO.

1084 IVANHOE ROAD • CLEVELAND 10, OHIO

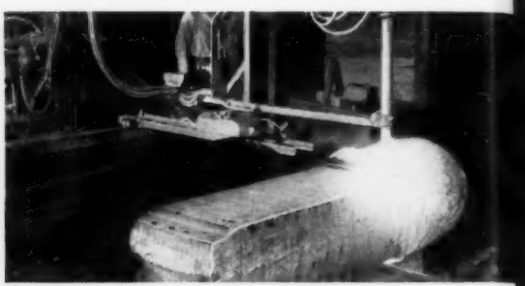
"Motor-Drive is More Than Power"



At the blast furnaces and open hearths, oxygen plays an important part. Furnace-tapping with the oxygen lance—oldest use of oxygen-cutting in steel plants—still saves time and reduces hazards.

Help on the Hot and Heavy Jobs

Ingots requiring 200 hours for mechanical "parting" have been split with the OXWELD C-45 heavy-duty blowpipe and then machined in 14 hours total time.



Cutting the hot top off this 26-inch forged slab with the C-45 blowpipe took less than 10 minutes and left the slab end square and undeformed.

The deseaming blowpipe, equipped with the OXWELD starting-rod feed, has reduced conditioning costs more than 50 per cent.

Draining furnace salamanders by oxygen-lance tapping has reduced furnace down-time more than three weeks in some steel plants.

LINDE service engineers who co-operate closely with the steel industry—have combined experience, knowledge, and practical "know-how" to help make better steel, faster, and at lower cost.

LINDE engineering service is always available to LINDE customers through the nearest LINDE office.

Linde

The words "Linde" and "Oxweld" are registered trade-marks of Units of Union Carbide and Carbon Corporation.

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

30 East 42nd St., New York 17, N. Y. UCC Offices in Other Principal Cities

In Canada: DOMINION OXYGEN COMPANY, LIMITED, Toronto

Increase Efficiency Throughout the Mill

with

Morgan Equipment

1. Available to you is a staff of **Rolling Mill Specialists** always ready to show you the newest ideas in mill layout and equipment.
2. **Morgoil Roll Neck Bearings** on your present stands will increase the accuracy of your products and increase the yield and reduce maintenance costs.
3. **Morgan-Connor Wire Machines** are designed to operate faster and more efficiently, to reduce power, die and maintenance costs and to make the maximum use of floor space.
4. Increase furnace capacity and efficiency with an **Isley Furnace Control System.** It gives positive control of the furnace, makes better use of fuel, melts more metal per hour.
5. Control hot gases and fumes with a **Morgan Air Ejector.** Gases as high as 3000° F. can be handled without injury to the equipment because they do not pass through the fan.

Our entire organization is ready to go to work on your problem. Why not get in touch with us?

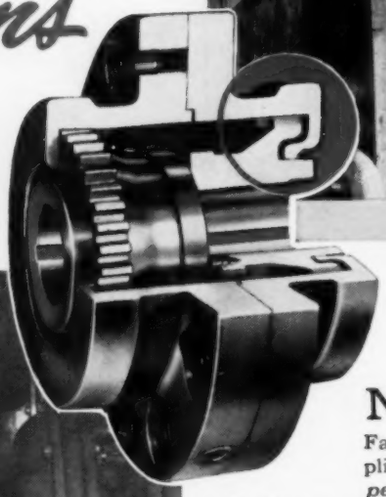
MORGAN CONSTRUCTION CO.
WORCESTER, MASSACHUSETTS

English Representative: International Construction Co.
56 Kingsway, London, W. C. 2, England

CO-2

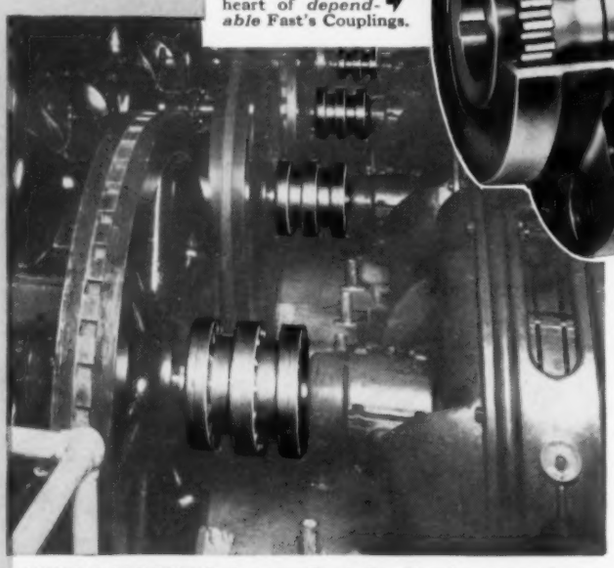
MORGAN
WORCESTER

Here's Freedom from *Coupling Shutdowns* for ALL INDUSTRIES



Here's the *exclusive* "rocking bearing," heart of *dependable* Fast's Couplings.

IN OIL FIELDS Fast's are in service to compensate for shaft misalignment, in all kinds of weather, subject to moisture, dirt and grit . . . yet they transmit power without costly coupling shutdowns!



CHEMICAL PROCESSING plants use Fast's Couplings because *exclusive* metal-to-metal seal keeps out impurities—eliminates lost time due to coupling failure! These Couplings have been in service since 1922!

STEEL MILLS specify Fast's Couplings for equipment of every shaft size to avoid costly production shutdowns caused by failure of ordinary couplings! This Coupling has been in use since 1923!

NO matter what you make—no matter how much horsepower you use in a year—Fast's Couplings virtually eliminate all coupling failure in your plant! There are *no perishable parts* to wear or fail in Fast's! Nothing to replace . . . they're easy to maintain. Even the load-carrying oil is *completely guarded* by a positive metal-to-metal seal formed by exclusive "rocking bearing" principle of construction.

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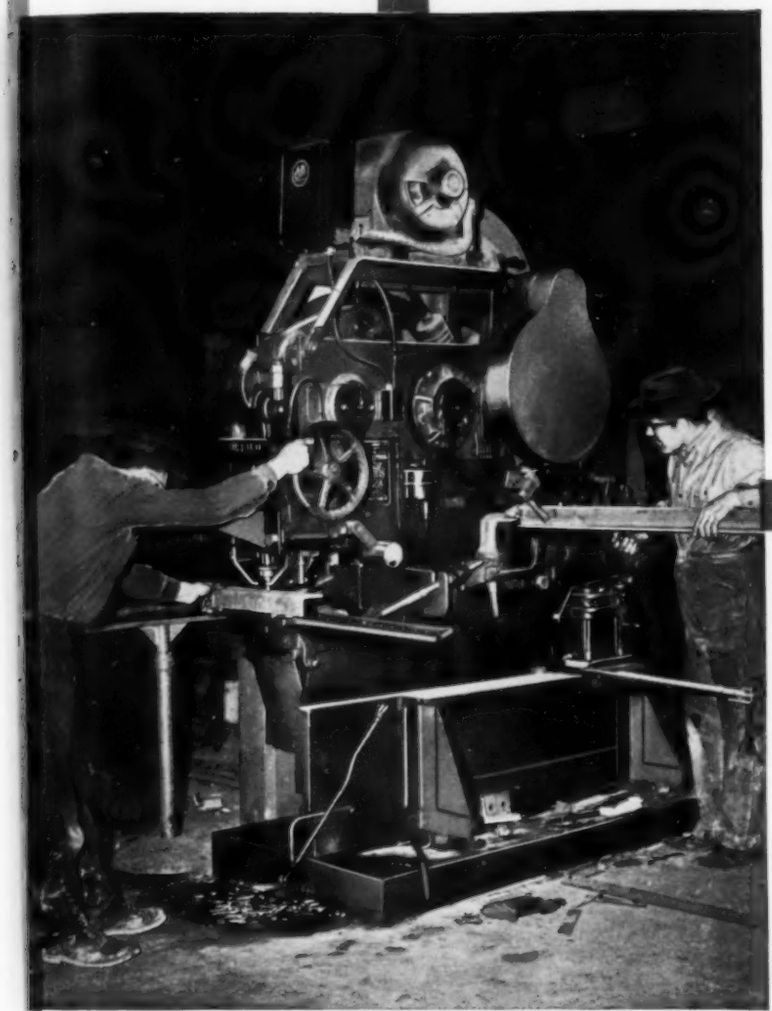

1. Mitre angles at 45° leg up or leg down, right or left hand mitres.
2. Shear rounds, squares, angles, tees, beams, channels.
3. Shear plates and flats — trim one leg of angles.
4. Punch girders in flanges, H-columns in flanges, I-beams in flanges, girders in webs, H-Columns in webs, I-beams in webs, Bethlehem I-beams in flanges or webs.
5. 90° notch angles, flanges of tees, flanges of beams, flanges of channels, also plates.
6. Coping (with built-in square coper on shear end) of angles, tees, flanges of channels, and plates.
7. Cut round and square bars — do many other fabrication jobs with special quick-change tools available.

PUNCH - SHEAR - CUT

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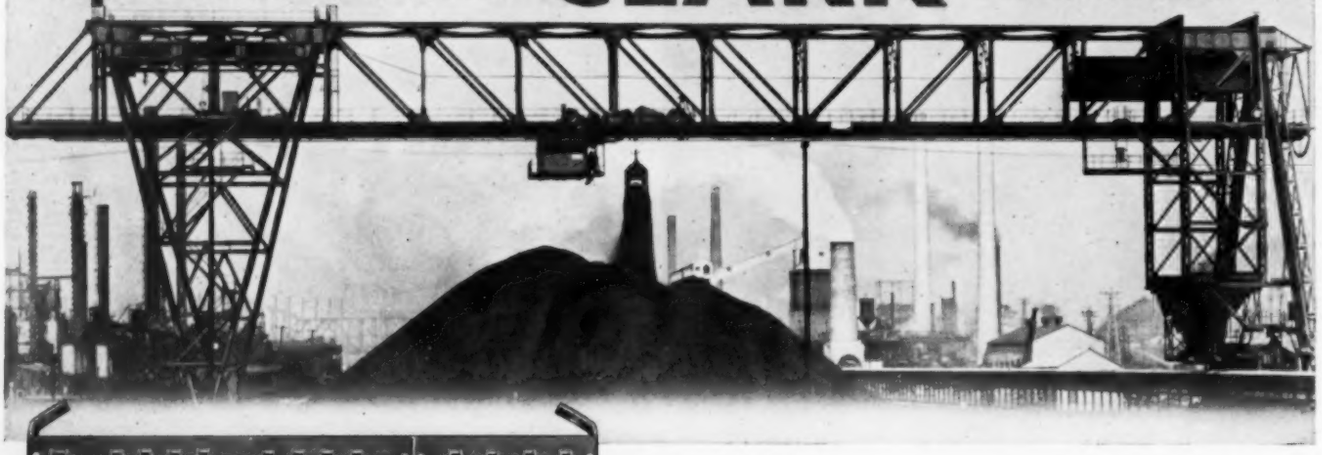

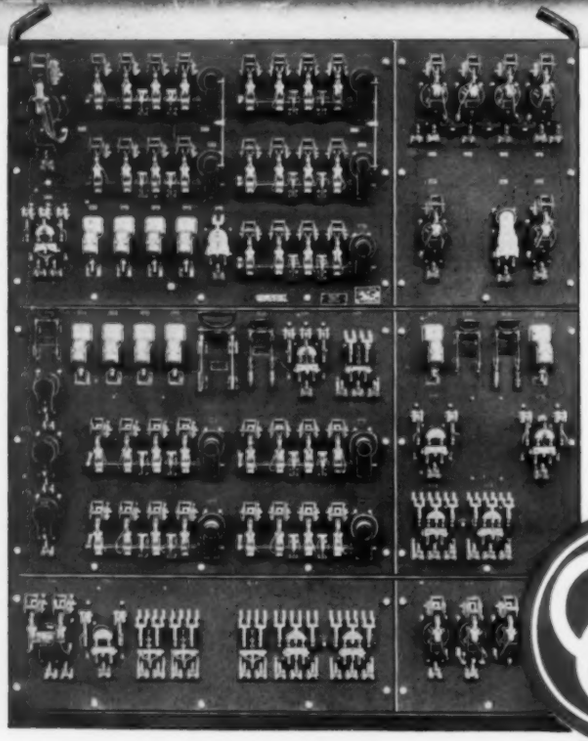

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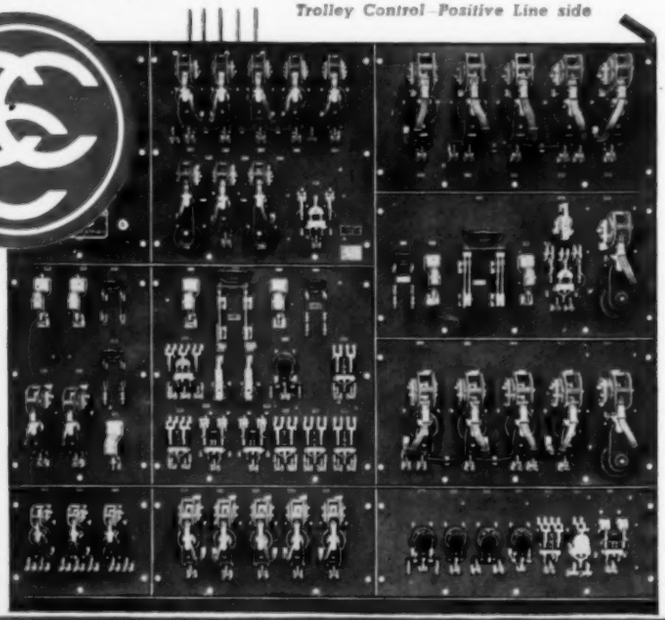
Shear Leg Control Panel

Trolley Control—Positive Line side



Motors and H. P. are as follows:

Closing Line	187½ HP	Shear Leg Drive	Four, 19 HP
Holding Line	187½ HP	Hopper Gate	19 HP
Trolley	Two, 75 HP	Rail Clamp	Two, 6½ HP
Pier Leg Drive	Four, 19 HP	Blower	7½ HP

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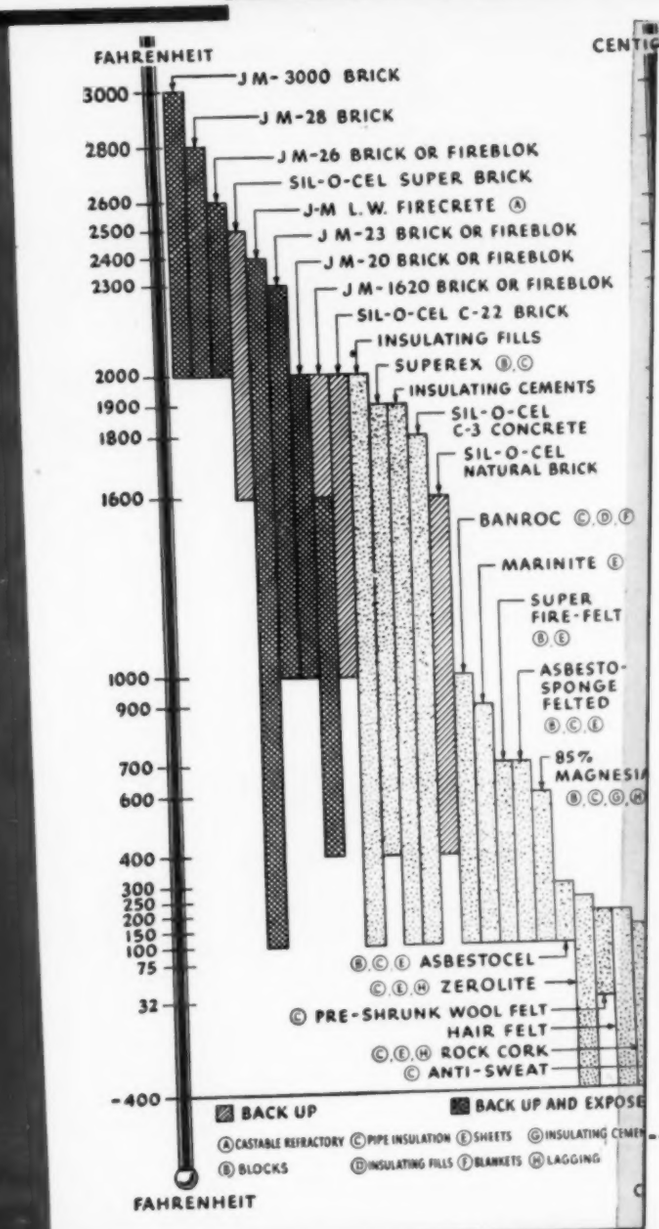

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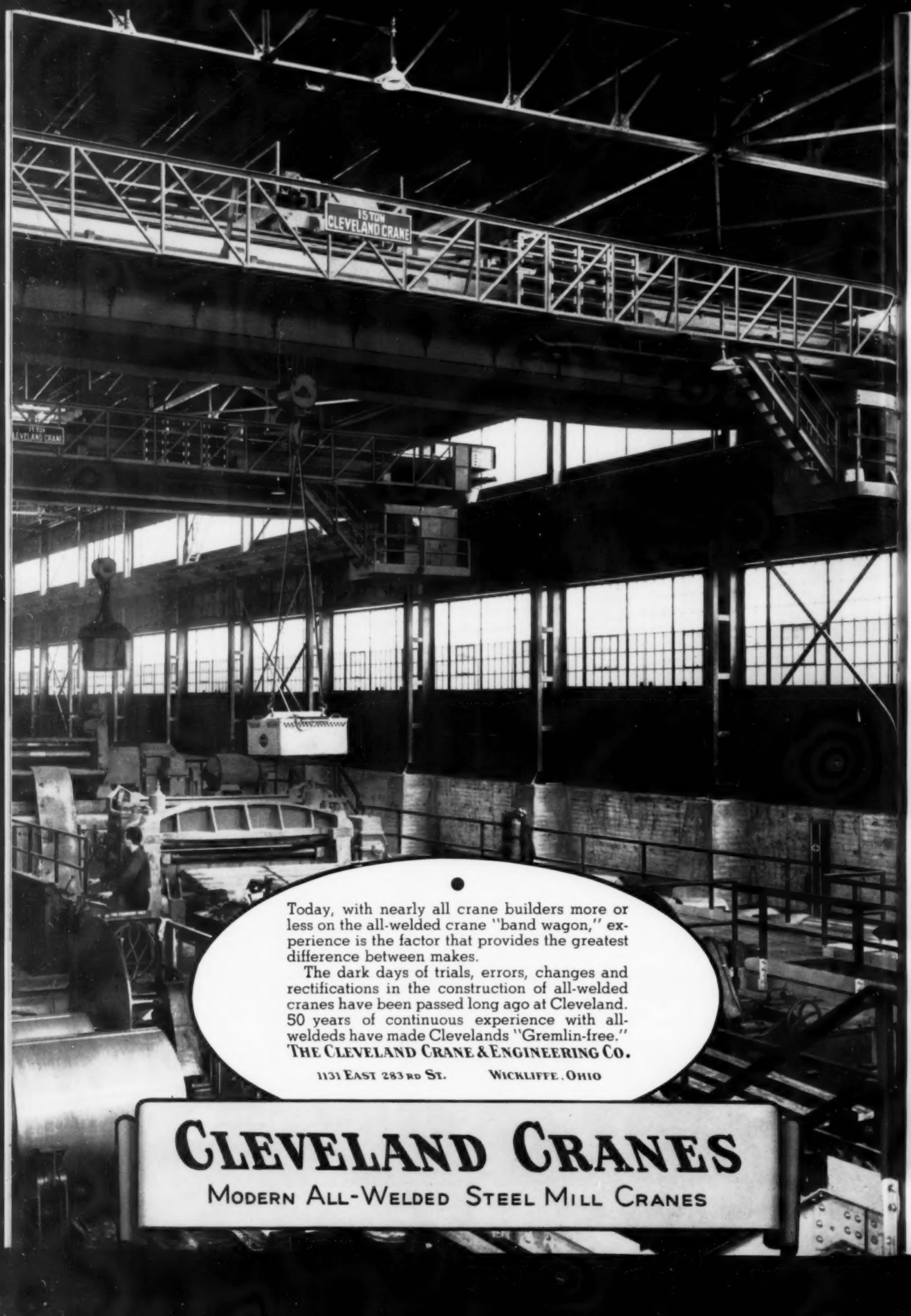

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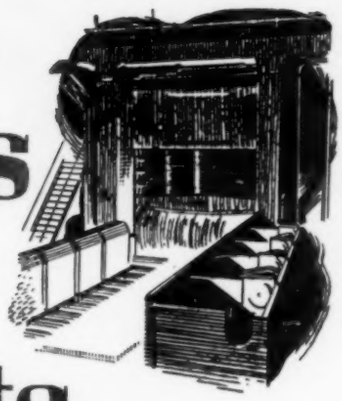


STEEL production in 1949 is off to a flying start, according to figures released by the American Iron and Steel Institute, with January showing an all-time monthly record at 8,172,236 net tons of ingots and steel for castings, and February totaling about 7,430,000 net tons, the highest ever recorded for that month. Although it is too much to hope that this rate of operation, which is over 100 per cent and which would indicate a production of more than 96,000,000 tons for the year, can be maintained throughout the year, it can be said that, barring interruptions in production, 1949 will establish an all-time production record. The addition of 2,183,000 tons of new capacity in 1949 will help to accomplish this. This addition to the present capacity of 96,120,930 tons, plus 540,000 tons planned for 1950, will bring the national capacity to more than 98,800,000 net tons per year. The annual capacity of the industry has climbed at the rate of approximately 10,000,000 tons per decade until the decade just ended, when 14,000,000 tons were added.

▲

SOME other statistics from the American Iron and Steel Institute are also interesting:

Iron or steel is now produced in more than 400 plants scattered through 30 of the 48 states.

Between 1938 and 1948, ingot capacity has been increased 17.5 per cent.

The 1948 payroll was $2,234,461,000 with an employment of 647,600 and an average rate of $1.63 per hour.

Raw material requirements for a full year of 96,000,000 tons of ingots and 70,000,000 tons of pig iron are approximately 130,000,000 net tons of iron ore, 50,000,000 tons of scrap, 111,500,000 tons of coal, 1,546,000 tons of manganese ore, 634,000 tons of chrome ore, 144,000 tons of metallic nickel, and large quantities of fuel oil and natural gas equivalent to another 16,000,000 tons of coal.

▲

ONE of our correspondents defines bars as something which if you go into you are apt to come out singing a few and maybe get tossed behind.

▲

ABOUT this time each year all of us are particularly conscious of taxes. According to the New England Letter, published by the First National Bank of Boston, expenditures by governments — federal, state and local — in the United States is now about 30 per cent of our national income. The federal government alone is spending at the rate of $984 per family, as compared to $250 in 1938 and $121 in 1929. Additional ideas have been advanced for pensions and other benefits that would increase this spending materially.

This must stop sometime, but it won't until the majority of the people are made to realize that you can't get something for nothing. If the prevailing rate of increase continues, it won't be many years before the government is collecting 100 per cent of our income. Then we will have communism or complete socialism. We can't say which because, although we have studied the definitions of both, we can't distinguish between the actual results of the two.

▲

A SURVEY reported in a pamphlet issued by the Bureau of Economic Research at University of Notre Dame highlights the need of enlightening people on the true economic picture. The survey showed that those polled believe that about 34 per cent of total wages and salaries go to those with incomes over $5000 per year, whereas the actual figure is less than 12 per cent. Likewise, the opinions held that people with incomes above $5000 received 71 per cent of total dividends and interest and 70 per cent of total rents. The actual figures are, respectively, less than 31 per cent and less than 17 per cent.

These figures show clearly the fallacy of the "soak-the-rich" policy. Bond-holders and landlords aren't as bloated as they are reputed to be.

▲

C. E. BLEICHER, president of Chrysler's De Soto Division, says that when they can't find an easy way to do a difficult job around the plant, they put a lazy man on it. He will find an easy way in ten days or less.

▲

PRESIDENT TRUMAN has stated that he has ample power to halt strikes affecting the nation's health and welfare without having such authority spelled out in the new labor bill. No one who watched Mr. Truman's demeanor during last year's election would call him a pessimist, and we wonder if he isn't being overly optimistic now. Certainly, he seemed glad to use the injunction clause in the case of the miners and railroads last year.

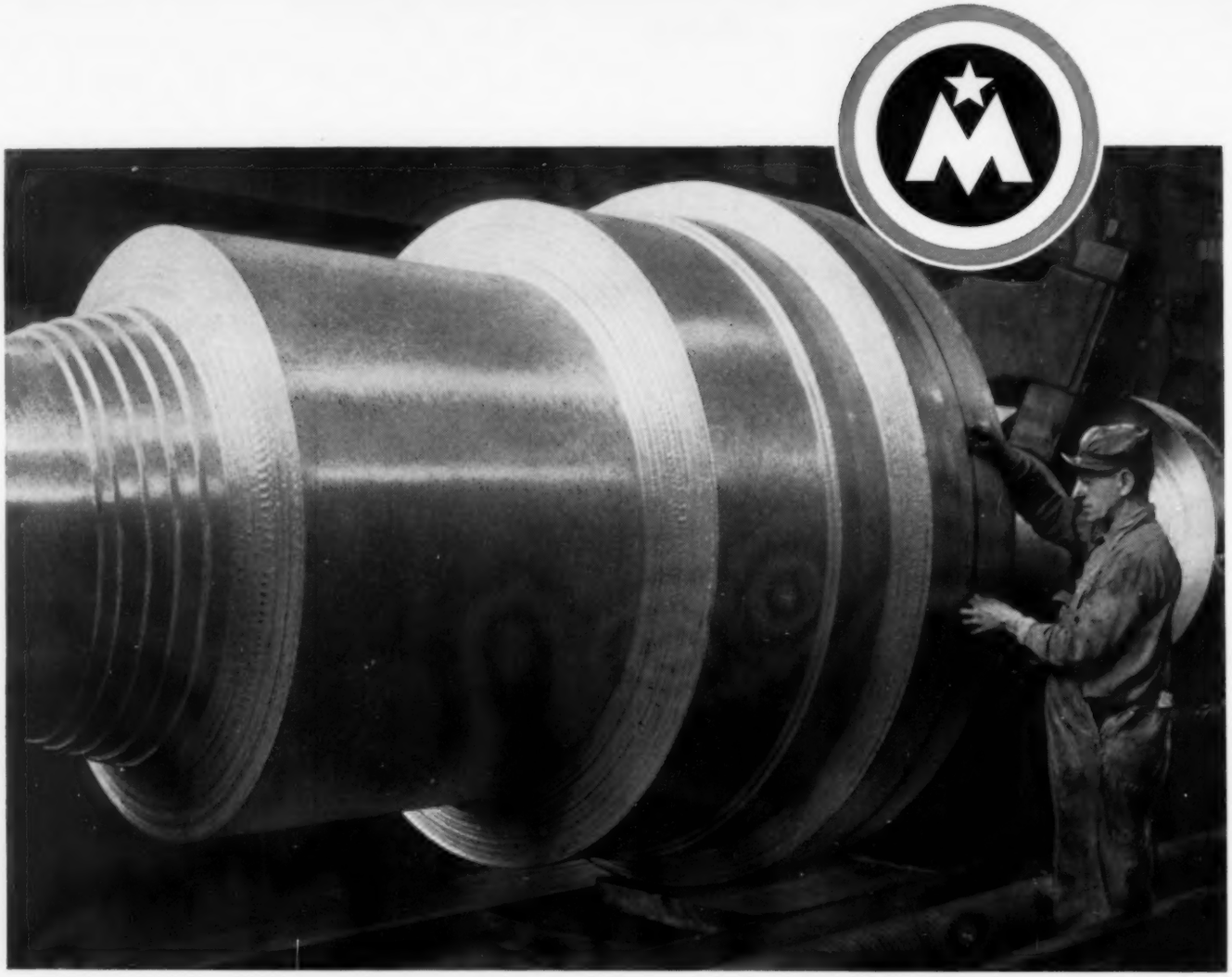
▲

RUNNING across a definition of an executive as "a man who wears a frown on his assistant's face" reminded us of a mill superintendent we used to know. Every day or so this superintendent would walk through his plant passing the time of day with the men, inquiring about their families and being a good fellow generally. Upon returning to his office, he would give his assistant a big list of things he saw that should be corrected. The assistant would then cover the same ground with the criticisms, and of course would be thought an old crab because "the big boss was just here and didn't say a thing about it — but then he's a regular guy."

Oh, well! what are assistants for?

▲

ACCORDING to Calvert Carey, president of Yale and Towne, the volume of material handling equipment business has increased to five or six times its prewar volume. Of course, the war with its manpower problems stimulated this growth, but not to be overlooked is the fact that, as labor costs go up, larger expenditures for labor-saving equipment can be justified.



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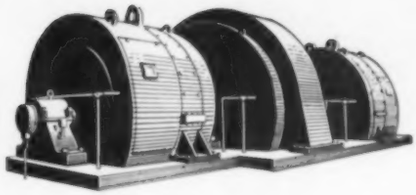
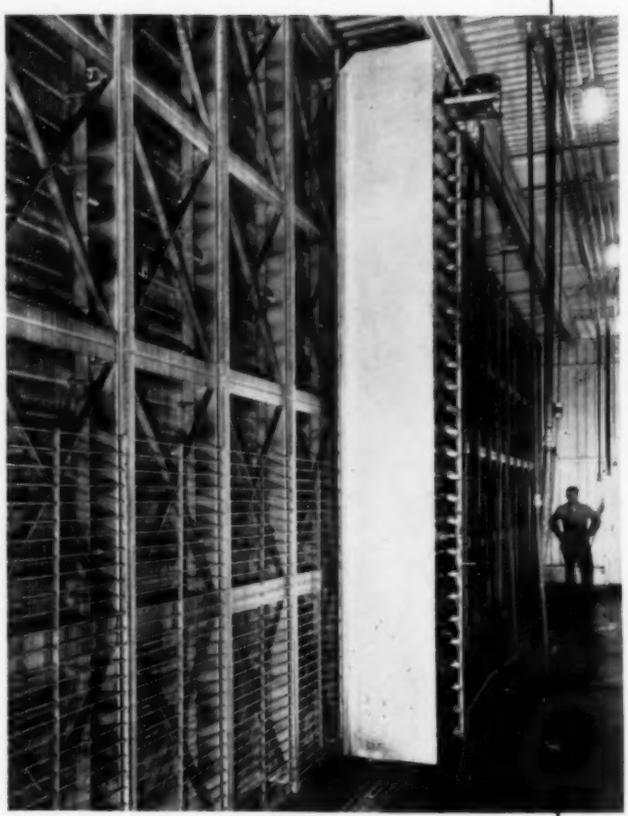


AAF Electro-Cell combines high cleaning efficiency with ease of maintenance



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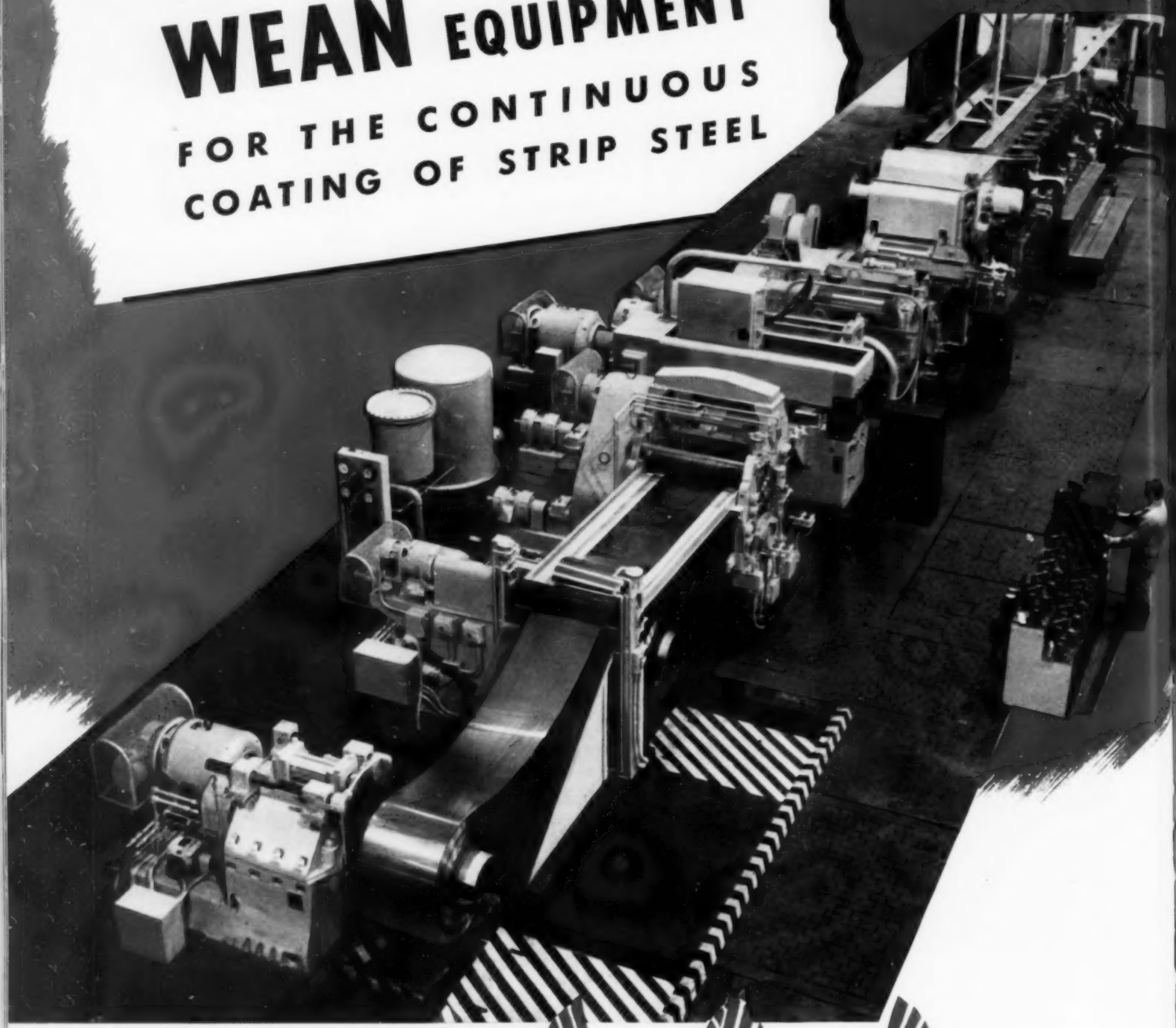

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Iron and Steel ENGINEER

MARCH, 1949 VOLUME XXVI NUMBER III

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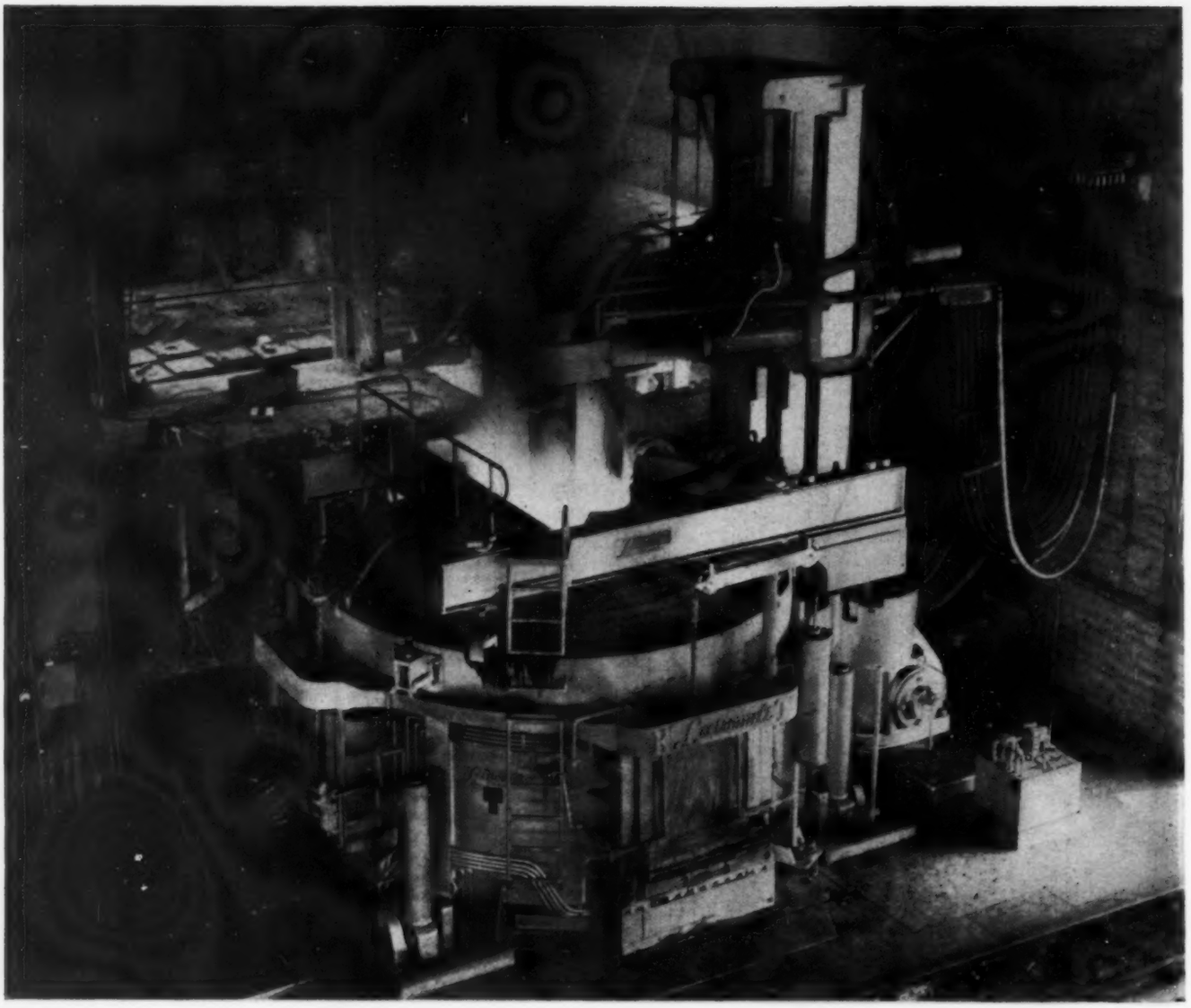

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Mercury Arc Rectifier Operations
IN CARNEGIE-ILLINOIS PLANTS

. . . . the operating records of the mercury arc rectifier installations used by this company show satisfactory performance and practically no trouble other than the usual initial adjustments . . . .

By FRANK W. CRAMER
Electrical Engineer
Carnegie-Illinois Steel Corp.
Pittsburgh, Pa.

▲ THE use of mercury arc rectifiers to supply the direct current power for auxiliary drives in our steel mills has increased rapidly during the past ten years. This increase follows the general trend in many industries in the use of this type of equipment to convert alternating current to direct current, and at the present time, the aggregate capacity of mercury arc rectifiers installed in the United States and Canada is about 5½ million kilowatts.

Mercury arc rectifiers have practically superseded rotating type a-c to d-c converters for d-c voltages above 200 volts and in capacities above 200 kw, except for our large main d-c drives where speed variations required are beyond the range of the field control.

Some of the reasons for using the equipment are:

1. *"They are static equipment, are quiet in operation, require no special foundations, and can be installed in locations unsuitable for rotating machines.
2. "They can be switched on and off like a transformer, require no synchronizing and no polarity checks, are adaptable for automatic or remote control. They can operate on any commercial power system frequency and are relatively unaffected by a-c system disturbances. Faults can be cleared quickly without damage and with only a short service interruption.
3. "They have a relatively high efficiency over the greater part of the load range, and their idling losses are low.
4. "The operating and maintenance costs are generally lower than for rotating machines."

Until about ten years ago all mercury arc rectifiers were of the multianode type with 6, 12, and 18 anodes per tank. This design has been superseded by the single anode type construction of the ignitron and excitron types. These consist of groups of either 6 or 12 single anode tanks assembled in a group to form a unit.

This construction has replaced the multi-anode types for several reasons.

1. *"Lower arc drop and consequently higher efficiency.
2. "Simpler maintenance, because individual tanks or tubes can be removed and replaced without affecting the others of the group.
3. "More adaptable for quantity manufacture, because a larger number of duplicate parts are involved.
4. "Fewer sizes are needed, because higher ratings can be obtained by increasing the number of tubes per group."

These units can be obtained in either the pumped type or the sealed tube. It has been customary to use the sealed tube type in the smaller sizes, under 500 kw, but improvements in tube life have developed a trend to using the sealed tube type in the higher ratings.

At the present time it is not possible to give accurate data on the life of the sealed tubes. Due to changes in ignition circuits and improvements in tube design since 1943, there has been insufficient time to establish normal life. The warrantee period is now 6 years and few tubes have been in service that long.

During the development period of rectifiers several problems were encountered. One of these was corrosion in the vacuum tank and water jacket caused by the use of raw water. This has been overcome by using the heat

*In the preparation of this paper, the information marked with an asterisk and surrounded by quotation marks was taken from American Institute of Electrical Engineers technical paper 48-188 titled, "Mercury-Arc Power Converters in North America" by the Working Group of the Electronic Power Converter Committee of which the author is a member.

A 200-kw sealed tube rectifier is located at the marine ways, and gives high efficiency for the normal light load.

Presented before the AISE Annual Convention, Cleveland, Ohio, September 28, 1948

exchanger. Another problem was the high currents during arc backs. Improvements in transformer design and high speed breakers solved this trouble and in addition, the use of better materials, improved design and operating experience greatly reduced the number of arc backs. On the 250-volt, d-c units they have practically been eliminated.

To show the widespread use of mercury arc rectifiers, Table I has been included in this text. From this you

TABLE I

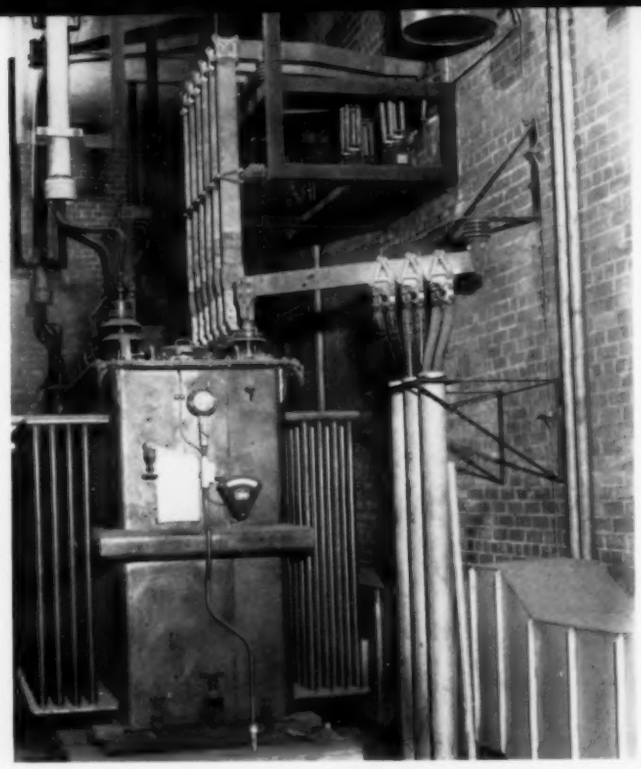
Estimated Capacity of Mercury-Arc Rectifiers Installed or on Order up to January 1, 1948

Application	United States	Canada
Electrochemical		
Aluminum	1,743,000 kw	1,201,000 kw
Chlorine	680,000 kw	11,000 kw
Magnesium	122,000 kw	....
Zinc	29,000 kw	29,000 kw
Hydrogen	....	61,000 kw
Others	98,000 kw	....
Electrochemical Total	2,672,000 kw	1,302,000 kw
Railway		
600 Volts	714,000 kw	57,500 kw
1,500 Volts	42,000 kw	3,000 kw
3,000 Volts	46,000 kw	1,500 kw (2,400 V.)
Railway Total	802,000 kw	62,000 kw
Industrial	247,000 kw	11,000 kw
Mining	149,000 kw	....
Sub-Totals	3,870,000 kw	1,375,000 kw
Grand Total	5,245,000 kw	

will note that the electrochemical and railway industries are the largest users. The industrial group which includes the steel mills have 247,000 kw installed which represents about 6 per cent of the total installations in the United States.

The Electronic Power Converter Committee of the American Institute of Electrical Engineers has completed work on a standard for the mercury arc rectifiers. In this standard it is recognized that railway service, electrochemical processes and industry, each need units with different characteristics. The railways in the heavy duty service require ratings of 300 per cent for five minutes to take care of the acceleration period of heavy trains. The electrochemical industry is not interested in overloads, but wishes to maintain a constant voltage on the cells. The steel industry wants units whose performance will duplicate those of motor-generator sets. For this reason, the standard rating for steel mill units is 125 per cent of the rated load for two hours and 200 per cent load for one minute. The rectifier transformers are designed for a temperature rise of 60 C at the two hour rating.

Since 1940, the Carnegie-Illinois Steel Corp. has installed 20 units totaling 19,700 kw of 250-volt, d-c mercury arc rectifiers. At the present time, two 1,000-kw. 250-volt units and two 500-kw units are in order. In addition there are two installations of electronic frequency changers in operation, the one at Gary originally rated at 6,677 kw now being increased to two 8,000 kw units for a total of 16,000 kw, and the 20,000-kw in-



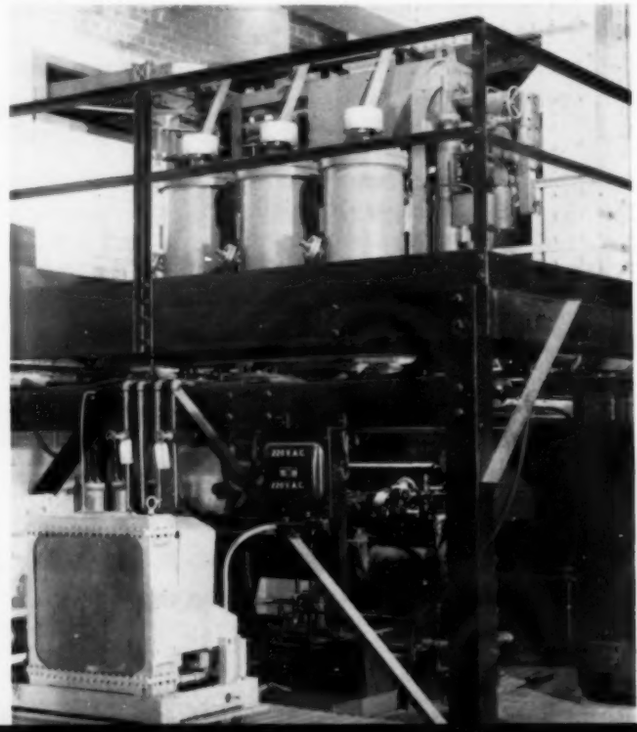
An outdoor transformer installation is used for the 500-kw rectifier of the electric furnace department at the Duquesne Works.

stallation at the Edgar Thomson works. The above adds up to a total installation, when the new work is completed, of 94,700 kw of rectifying units.

The units are all of the single anode type, and with the exception of the 20,000-kw electronic frequency changer, a small 200-kw unit at Clairton and the two 500-kw units on order are of the pumped type. Recently, we have made studies of d-c load concentrations in two of our smaller plants which resulted in decisions to use 500-kw units at d-c load centers. These will be of the sealed tube type and be representative of the plans using a minimum of copper for feeder lines.

In planning for these installations, it must be borne

Rectifier and auxiliary equipment for 500-kw unit, electric furnace department at Duquesne Works.

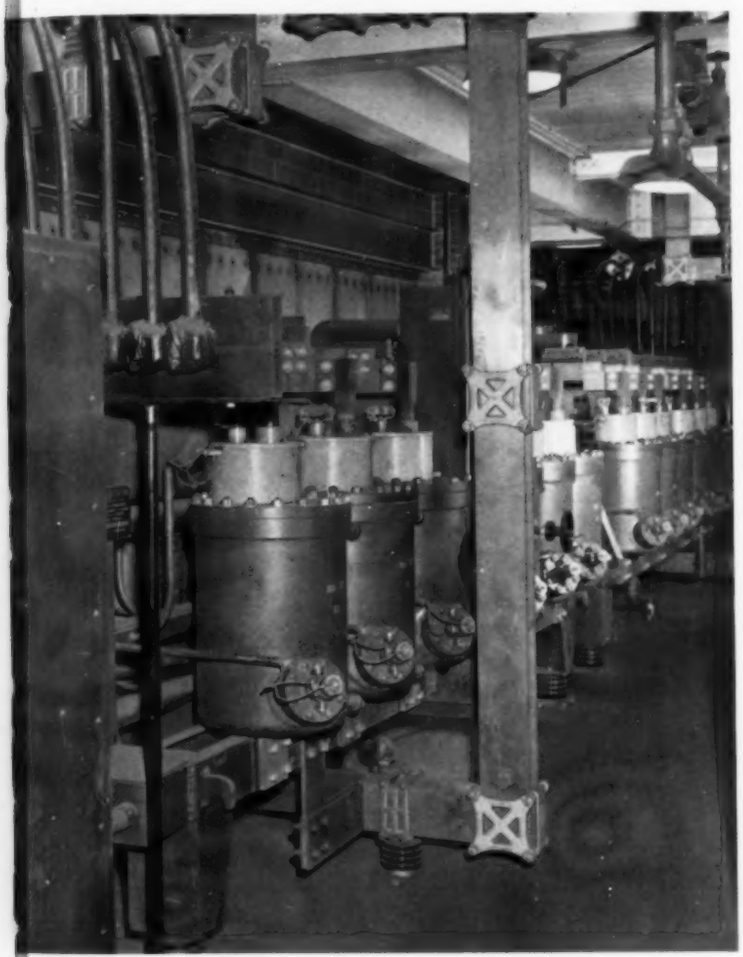


in mind that a rectifier will not in itself handle regenerative power. If they are to supply d-c power to cranes or any overhauling loads, a dynamic braking panel must be added to the equipment.

Another characteristic to be considered is that they do not correct the power factor, and the power factor of the unit with regulated voltage will be from 91 to 94 per cent lag.

They will also have a higher efficiency than the rotating equipment and for the smaller units (300 to 500 kw) an approximate figure for this advantage is 15 kw per hour of operation.

The primary object of this paper was to review the operating records of the foregoing equipment, and discuss the troubles that have been encountered. The review, however, indicated that the operating records have been good and if the starting up periods are omitted, there is little to report on operating difficulties. The units have functioned as unattended transformer substations with only routine inspections and minor repairs.



Rectifier tanks for 1500-kw unit are located on the charging floor of the open hearth department at Homestead Works.

Perhaps the most interesting features of these installations are the design layouts, which fit them into a variety of locations where both the space and the shape of the space had limitations. Several of these are illustrated later in the paper.

Records show that the first mercury arc rectifier for steel mill use was installed in the South Chicago plant of Republic Steel Corp. in 1936. This unit is of the multi-anode type and has given satisfactory service with very little maintenance cost. In 1947 it was overhauled for the first time, which indicates a possible ten year period before a major expense is required. None of the Carnegie-Illinois installations are ten years old, and none have required overhauling. Due to improvements in design, the single anode type should have a better maintenance record than the multi-anode type.

The following information concerns several installations in the Carnegie-Illinois Steel Corp. plants:

1. Edgar Thomson Works—1,000-kw unit.

The first unit of the electronic type for conversion of alternating current to 250-volt d-c in Carnegie-Illinois Steel Corp. plants went into operation June 1, 1940 at the open hearth substation—Edgar Thomson works. This location is adjacent to the East Pittsburgh works of the Westinghouse Co. who supplied this equipment. Since this was the first rectifier installation to be used as an important source of d-c power for an open hearth shop, it was thought an advantage to be close to the source of maintenance assistance. This rectifier was purchased as two 500-kw units with a common transformer, and equipment with disconnecting switches so that either half could be used in case of trouble with the other.

Most of our anticipated troubles did not happen and although we did experience periodic missing and stoppage in firing due to wetted ignitors, no major repairs were required.

About two years ago these tanks were rebuilt with adjustable externally operated ignitors, the control circuits modernized and other minor changes made so that this unit now represents up-to-date design.

The high speed breakers in the d-c circuits of these units are equipped with counters. By eliminating the operations caused by shutting units down for inspection and adjustment, the foreman in charge estimates that in seven years of operation there have been only 6 circuit breaker openings due to trouble in the unit.

From June 1, 1940 to April 1, 1947 this unit has converted 32,824,000 kw of a-c to 29,540,000 kw of 250 volt, d-c power which gives an average efficiency for about 7 years operation of 90.2 per cent.

This unit was designed so that the initial operation could be on 25 cycle power, and at a future date by taking out the reactors and making a few minor changes it could be operated with 60 cycle power.

2. Marine Ways—200-kw sealed tube unit.

To maintain operations of the river boats and barges, the corporation has facilities for repairs and inspection at the Marine Ways on the Monongahela River. The machine tools and miscellaneous loads at this location require about 70 kw of direct current. However, when a boat is to be pulled up the ways, about 250 kw is required. This operation occurs about twice a month. Due to the much higher efficiency of the electronic rectifiers at light loads, which is the usual condition at this operation and the short time peaking capacity of the rectifier, this type of unit showed considerable savings both in power consumption and initial cost over rotating equipment.

This unit is of the sealed tube type and went into operation in January, 1942. The following is the record of tube life:

No. 4 tube replaced 9-8-46, operated 4 years and 7 months.

No. 1 tube replaced 12-2-46, operated 4 years and 11 months.

No. 3 tube replaced 12-2-46, operated 4 years and 11 months.

No. 4 tube replaced 6-20-47, operated 0 years and 9 months (replacement).

The No. 2 tube was replaced with a permanent tube on October 30, 1943, the original having been borrowed to allow shipment of the unit. The replaced tube is still in service.

The tubes have a 3 year guarantee and cost about $250. Hence, in 6½ years we have spent $750 for tubes or an average of $114 per year.

3. Duquesne Works.

A. Two 500-kw units—heat treating department.

These units went into service in March, 1943. Some troubles were experienced during the starting up period with the water seal pump, the ignition circuits and with one tank that back-fired. These were corrected and the units have had no repairs since that time.

B. Two 500-kw units—electric furnace plant.

These units were installed in 1942. An attempt was made to use river water for cooling in the heat exchangers. This was not successful and city water was substituted. One of the vacuum pumps had to be rebuilt. Since 1943, no repairs or troubles have been reported.

4. Ohio Works—1,500-kw unit at open hearth.

This unit installed in 1947 to operate on 25 cycle power has recently been changed over and now operates on 60 cycle power. It is located under the trestle, close to the load center and has experienced no operating troubles.

5. Homestead Works—Two 1,500-kw units.

This is a unique installation in that the units are located on the open hearth charging floor, with the rectifiers and transformers on the floor level, and the switchgear and distribution panels on a balcony above, which results in a long narrow installation.

The No. 1 unit was placed in service June 14, 1943 and the No. 2 unit September 2, 1943. In February, 1944, trouble developed in one of the transformers due to an insulation failure and it was rebuilt at the factory. Anticipating the same trouble in the No. 2 transformer, it was also rebuilt. At this time a new design of baffle was installed in all tanks.

Since these repairs, there have been no operating troubles and so far as we know no backfires. These units operate on swing loads up to 8,000 amperes.

6. Gary Sheet and Tin Mills.

A. 1,000-kw unit at sheet mills.

This unit, installed in 1941, was one of the pioneer applications of single anode power rectifiers in the steel industry. Several weaknesses in the excitation and ignition systems had to be improved after the unit was in service. Wattmeter readings show that for about 52,000 hours of service the average efficiency has been 85.2 per cent.

B. 1,000-kw unit at tin mills.

This unit was installed in December, 1943. Since then it has been in operation 99 per cent of the time with an average efficiency of 87.6 per cent.

Rear view of d-c switchboard for two 500-kw rectifiers at open hearth department, Homestead Works.

7. Gary Steel Works.

A. 1,000-kw unit—merchant mills.

This went into service March 8, 1942 and operates in parallel with a 1,500-kw motor-generator set 2,500 ft away. There is no difficulty in the parallel operation and no troubles have been experienced on the unit.

B. 1,000-kw unit—rail mill.

This unit went into service September 16, 1942, and operates in parallel with three 500-kw motor-generator sets located in the same motor room. The motor-generator sets have no voltage regulators and the voltage regulator on the rectifier was set with a drooping characteristic to match the motor-generator sets as closely as possible. The machines operate satisfactorily in parallel under normal conditions, but at times the frequency varies from 23 to 26 cycles, which affects the speed of the motor-generator sets and not the rectifier, and the voltage varies from 6,400 to 6,900 volts which affects the d-c voltage of the rectifier and not the motor-generator sets. When these variations occur, it is necessary for the attendant to make adjustments on the rectifier voltage regulator to obtain satisfactory operation. There have been no repairs or failures on this unit.

C. No. 1 open hearth rectifier—1,500-kw unit.

After placing this unit in operation January 10, 1943, there was a considerable amount of backfiring which resulted in a transformer failure. This was repaired and the trouble traced to a bad tank. This was replaced and no repairs or backfires have been reported since.

D. Machine shop rectifier—1,500-kw unit.

Unit placed in operation November 15, 1943. No repairs or backfires have been reported. This unit and also the one at the open hearth are both of the unit

Front view of d-c switchboard for two 500-kw rectifiers at open hearth department, Homestead Works.

substation enclosed type. The rectifiers, as well as the transformers, are streamline enclosed.

E. 44 in. blooming mill rectifier—1,000-kw unit.

Unit placed in operation June 22, 1944, and operates in parallel with a 1,000-kw motor-generator set in the same room. To cover the range of frequency and voltage swings, a direct connected exciter with a rheostatic voltage regulator was installed on the motor-generator set which allows a plus or minus 8 per cent full load voltage regulator on the rectifier to function.

No repairs have been made on this unit and no backfires reported.

F. Coke plant—1,000-kw unit.

Unit put in operation December 22, 1943. This unit serves an isolated load consisting of coke pushers, larry cars, and door extractors for No. 9, 10, 11, 12, and 14 batteries plus coke transfer locomotives.

No repairs have been made and no backfires reported.

G. Ore dock rectifiers—two 1,000-kw units.

In operation January 2, 1944. These are perhaps the most interesting of our rectifier operations. They are installed in vaults under the ore pile adjacent to the ore trough wall. Each rectifier vault is connected into the adjacent tunnel which runs under the ore pile from the blast furnaces to the slip. These tunnels are located approximately one-fourth of the length of the ore trough from each end. The trough is approximately 5,000 ft long.

The main load of these rectifiers are the five ore unloaders, three of which are rated at 25 tons. When an ore boat arrives, all five unloaders can be assigned to the boat which results in a concentrated d-c load at any location along the dock. The problem was to have these rectifiers divide the load regardless of the position of the boat.

The control scheme worked out uses a rotating voltage regulator in the south rectifier vault with its fields excited from the output of current transformers located in the 6,600 volt a-c power line feeding the rectifier transformers.

The rectified output from one of these line current transformers is impressed on one regulating field of the rotating regulator and makes the output of the regulator positive. The rectified output of the other line current transformer—2,600 ft away—is impressed on the other regulating field of the rotating voltage regulator and makes the output of the regulator negative. The output of this voltage regulator is fed through blocking rectifiers to the load compensating coils of the rocking section regulators. This raises the voltage on the rectifier which is carrying the lighter load. In this way when one rectifier tends to take more than its share of the load, the regulators raise the voltage on the other rectifier and it increases its load.

The vaults housing this equipment have been sealed off so that they are dry and, with heaters and a ventilating system, sweating is prevented.

These units have given very satisfactory service; no troubles or backfires have been experienced.

8. South Chicago Works—Two 1,000-kw units.

At the present time two 1,000-kw units are being installed in a new substation erected under the ore yard trestle near No. 12 blast furnace, South works. This location is close to the conductor rails that supply power to the three 25-ton bridges. These units will be operated through supervisory control from the local dispatcher's office. Installations of this type illustrate the unusual locations that can be utilized for this equipment.

9. Irvin Works—Two 500-kw units—sealed tube type.

These 500-kw units will be the first sealed tube units of this size installed in any of our plants. There are several unique features in this installation due to the space limitations.

The rectifier transformers are located outdoors adjacent to the transformer wall. Throat connected to the primary of each transformer is an interrupter switch, which provides for easy isolation of either rectifier unit. Both rectifiers are fed from one 6,900-volt metalclad switchgear. The secondary side of the rectifier transformers are bus connected through the substation wall to the heavy duty draw-out d-c circuit breakers. This will be the first installation of this type of switchgear with the draw-out feature.

The diactor type rectifier d-c voltage regulator supplied may be used to adjust automatically and continuously the phase control of the excitation circuit, and thereby control the d-c voltage. When adjusted to hold rated d-c voltage, the regulator will compensate for the approximately 7 per cent inherent regulation in the rectifier equipment plus rises in a-c system voltages up to 105 per cent of the value corresponding to the transformers tap setting.

This regulator will maintain the d-c voltage selected within plus or minus 1 per cent for all current loads up to the value of overload where the 7 per cent inherent regulation characteristic equals the selected d-c voltage.

These units will have practically flat efficiency curves

ranging from 0.898 at ¼ load to 0.91 per cent at full load.

ELECTRONIC FREQUENCY CHANGERS

The Carnegie-Illinois Steel Corp. has been one of the pioneers in the application of electronic frequency changers. In simple language, these are two sets of mercury arc rectifiers, the one set receiving alternating current at 25-cycle frequency, converting it to direct current. This in turn is fed into the direct current side of the second set which converts it to 60 cycle alternating current. These units will operate in either direction, that is convert 60-cycle power to 25 cycles or 25-cycle power to 60 cycles.

Electronic frequency changers were chosen for this service, because the 25 and 60-cycle power systems do not have a fixed ratio, and it was desired to regulate the transmitted power independently of voltage or frequency variations on either system. For these reasons synchronous-synchronous frequency changers could not be used. Other types of rotating equipment such as Scherbius induction-synchronous converter and two rotary converters were also considered.

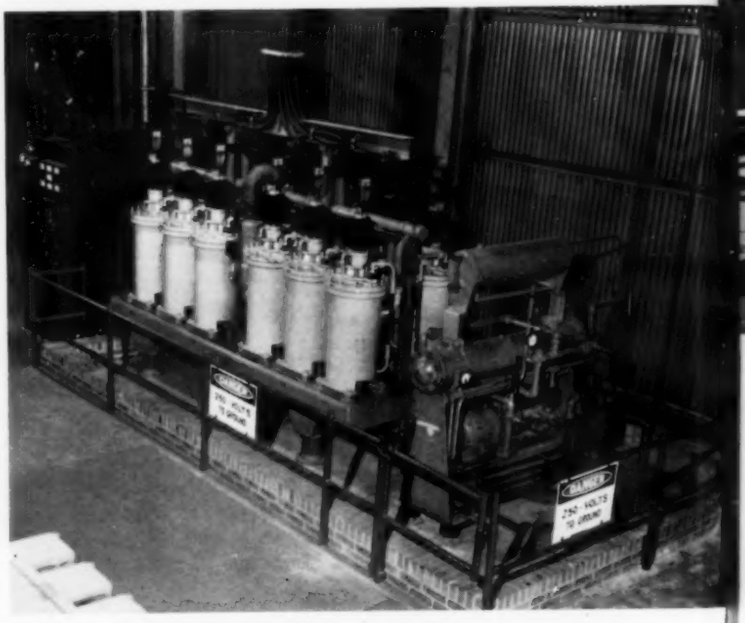
These electronic frequency changers have a higher efficiency at all loads than the rotating equipment. There is an ease of power flow control, ease of starting with no shock to the system, absence of rotating parts and low maintenance costs. The over-all efficiencies from 66,000 volts, 60 cycles to 44,000 volts, 25 cycles has averaged about 94 per cent. One of the disadvantages of this equipment is that it is not adaptable for a stub end feed. There has to be a supply of reactive power on both systems connected by the frequency changer. Since both our installations connect large generating systems, this was not a problem.

1. Two 8,000-kw electronic frequency changers in the Gary Sheet and Tin Mills.

The electronic frequency changer equipment as being furnished to Carnegie-Illinois Steel Corp.'s Gary sheet and tin mill will be used as a flexible tie between two a-c systems. It employs pairs of mercury arc converter units, one unit of each pair operating as a rectifier, and the other unit as an inverter. The systems are tied together by a d-c link. One system is a 60-cycle system supplied by the Northern Indiana Public Service Co., and the other is a 25-cycle system supplied by the Carnegie-Illinois Steel Corp. Pump-evacuated rectifier tubes are employed for this purpose with twelve tubes per converter being used.

The d-c link type of frequency changer circuit allows the choice of a d-c voltage that will best suit the conditions to be met. A voltage of 1750 volts was chosen for this particular system. This voltage is high enough to minimize the effect of arc drop losses inherent in mercury arc converters, and it provides a balance of d-c current and voltage that is easily handled by conventional switching equipment.

Each pair of twelve tube rectifier-inverter frame assemblies is designed to transfer 4,000-kw in either direction between the two a-c systems that are tied together. Two pairs of 4,000-kw frequency changer units are being provided to operate from one main transformer on each a-c system. This results in a twelve-phase secondary on the 60-cycle system and a double six-phase system on the 25-cycle system, and provides an 8,000-kw frequency changer installation which may be sectionalized, if necessary, into two 4,000-kw frequency changers. Two similar units each rated 8,000-kw are being supplied with the main transformers, connected to provide a resultant 24-phase secondary on the 60-cycle system, and a 12-phase secondary on the 25-cycle system.



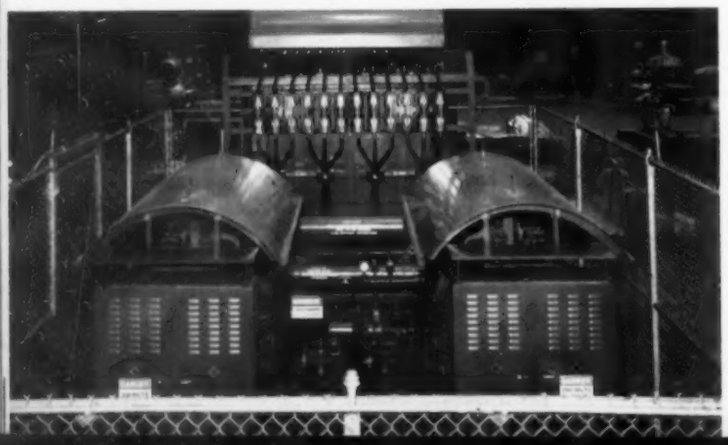
Installation of 12-tank, 1000-kw rectifier at Gary Sheet and Tin Mill.

This application requires the frequency changer equipment to handle both frequency and voltage variations on the two systems being tied together. The 25-cycle system is rated at 23 kv, with normal voltage variations from 21.2 kv to 23.8 kv, and momentary peaks and dips ranging from 24.15 kv to 20.5 kv. The frequency on this system varies from 23.5 to 26.5 cycles per second.

The 60-cycle system is rated at 6,900 volts, with normal voltage variations ranging from 6,600 volts to 7,080 volts, and momentary peaks and dips of 7,110 volts and 5,760 volts. The frequency on this system may vary from 59 to 61 cycles per second.

The frequency changer equipment is designed for either manual or automatic control, and for power

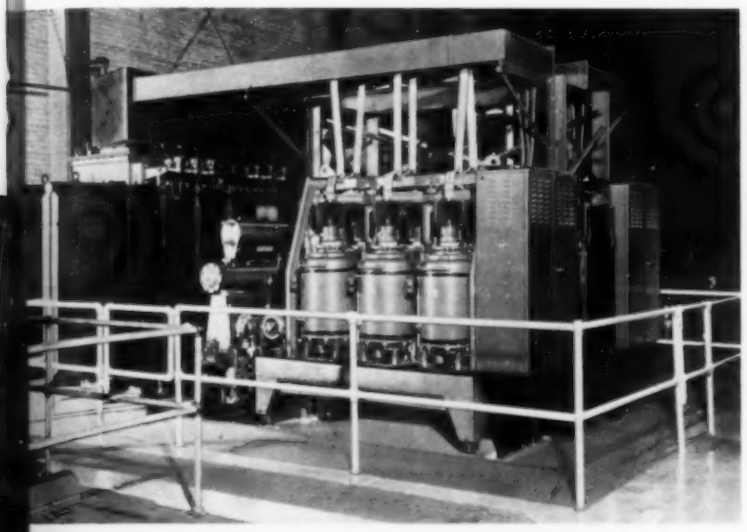
This rectifier unit is rated at 1000 kw and is located at Gary Sheet and Tin Mill.



transfer in either direction. The frequency changer station consists of two 8,000-kw units which may be operated together to provide 16,000 kw capacity, or they may be operated separately as the immediate condition may require. Each unit is designed for a two hour load of 125 per cent of continuous rating, providing a peak rating of 20,000-kw for the station.

Each 8,000-kw unit is provided with manual base load control, and automatic base load and peaking control in either direction.

The manual base load control will permit selection of a base load, in either direction, ranging from 12½ per cent of rated load to full rated load. This load will be automatically maintained within the limits of voltage and frequency variations of both systems, as outlined above.



Transformer and auxiliary equipment for 1000-kw rectifier in rail mill of Gary Steel Works are located together in a compact unit.

The automatic base load and peaking control, when the power transfer is from the 25-cycle to 60-cycle system, will provide for operation at a preselected value of the base load until such time as the plant load on the 60-cycle systems exceeds the allowable maximum demand stipulated by the supplier (Northern Indiana Public Service Co.). When the maximum demand is exceeded (determined by a demand meter) the control will allow the output of the frequency changer to reach a preset ceiling, thereby reducing the demand on the 60-cycle system. When the 60-cycle plant load drops below the allowable maximum demand of the system, the control will cause the frequency changer to drop to the preset base load. When the automatic base load and peaking control is in operation in this direction, the base load on each frequency changer will be adjustable between 1,000-kw and 5,000-kw, and the peak load ceiling will be adjustable between 5,000-kw and 10,000-kw.

When the direction of power transfer is from the 60-cycle to the 25-cycle system, the automatic base load and peaking control will provide for operation of the frequency changer at a preselected peak load (ceiling) until such time as the plant load on the 60-cycle system exceeds the allowable maximum demand. When the allowable maximum demand is exceeded (determined

Transformer, enclosed rectifier, and switchgear cubicles for 1500-kw rectifier used to furnish power for machine shop at Gary Steel Works.

by the same demand meter) the automatic base load and peaking control will cause the output of the frequency changer to fall to a preselected value of base load. When the plant load falls below the allowable maximum demand, the control will cause the output of the frequency changer to reach the preselected ceiling. The base load range will be adjustable between 1,000-kw and 5,000-kw, and the ceiling will be adjustable between 5,000-kw and 10,000-kw.

Each frequency changer unit will be provided with automatic load limiting control, which will function to prevent the output of the frequency changer from flowing into the public utility 60-cycle system.

A common load totalizing system will operate the demand meter to monitor the output of both 8,000-kw frequency changers. The controls of the two units are of the preferential type, allowing individual selection of base load and peak load ceiling for each unit.

The frequency changer units are designed to operate from a master control switchboard. They are made ready for operation by selection of the direction of power flow, starting of the auxiliaries, and closing of the incoming line breakers. When these operations have been performed, the equipment may be put into operation by closing the high-speed d-c breakers. Closing of these breakers will cause the automatic load control to load up the frequency changer according to the predetermined setting of the load control equipment.

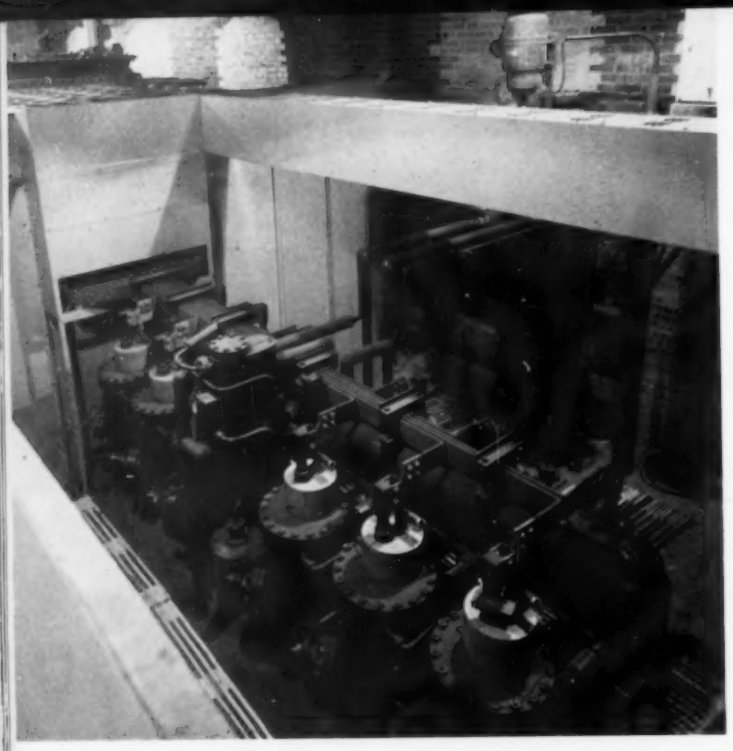
The electronic frequency changers may be taken out of operation and disconnected from the two incoming systems by opening the incoming line breakers, opening the high speed d-c breakers and returning the auxiliaries to the shutdown position.

The manual base load controls and automatic base load and peaking controls are located on the master control switchboard.

The frequency changer is provided with standard automatic protective equipment to provide against abnormal operating conditions. The protective equipment provided will function as follows:

A. Prevent starting of the frequency changer if:
   a. The excitation arcs fail to establish.
   b. The pressure of the cooling water in the circulating system is too low.
   c. The vacuum in the tubes is unsatisfactory for safe operation.
   d. The incoming system voltages are too high, too low, or unbalanced.

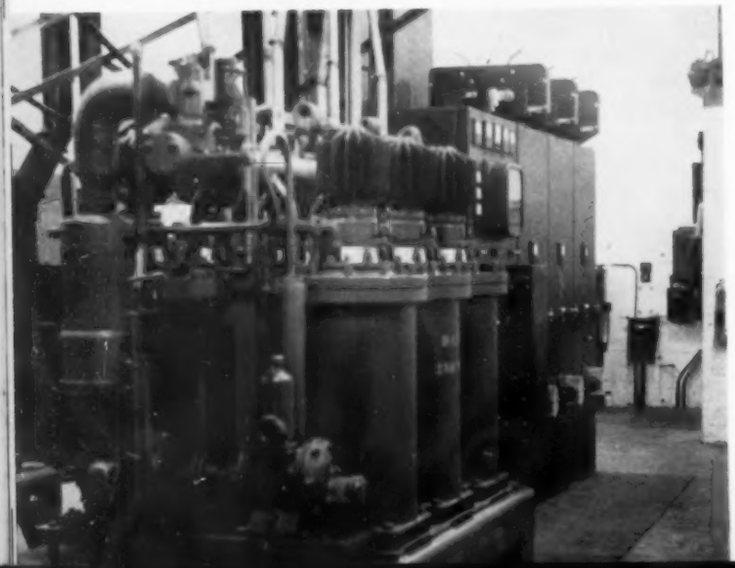
   Any of these faults will prevent the closure of the high-speed d-c breakers.



Rectifier units for 1500-kw rectifier at machine shop of Gary Steel Works.

South sub-station of 1000-kw rectifier at Gary Steel Works is located in a vault under the ore pile.

Interior view is shown below of south ore docks sub-station shown in above figure showing 1000-kw rectifier unit and control board.



B. The alarm will sound if:
   a. The excitation arcs fail.
   b. The temperature of the cooling water in the circulating system exceeds a safe value.
C. Shutdown and lock out the frequency changer equipment if:
   a. The temperature of the frequency changer transformer equipment exceeds a safe value.
   b. An arc back or short circuit occurs.
   c. A heavy overload occurs.
   d. The incoming system voltages are single phase or too low or too high for safe operation.
   e. The pressure in the cooling water circulatory system drops below a safe value.

2. Two 10,000-kw electronic frequency changers at the Edgar Thomson Works.

The two 10,000-kw electronic frequency changers located at the Edgar Thomson Works were placed in operation December, 1943. By means of these units, power may be exchanged in either direction between the 69,000-volt, 60-cycle system and the 44,000-volt, 25-cycle systems. Our 60-cycle system is interconnected with that of the Duquesne Light Co. and the total generating capacity exceeds 600,000-kw, while the generating capacity of the 25-cycle system is about 130,000-kw. The 60-cycle frequency is held within $\frac{1}{10}$ of a cycle while that of the 25 cycle varies from $23\frac{1}{2}$ to 26 cycles.

The main elements of this installation are as follows:

A. *"Two separately operable 10,000-kw units each consisting of two sections.

B. "The frequency changer, circuit has a d-c link, involving distinct power rectification, d-c interconnections and power inversion.

C. "Sealed pentode ignitron tubes are used which permitted the use of a double-way transformer circuit. Such a rectifier transformer is simpler and physically smaller than a single-way transformer. If pumped ignitrons were used, they would have required transformers with single-way connection of the d-c windings, because their cathodes are interconnected by the vacuum pumps.

D. "Both 60 and 25-cycle transformers have delta and wye a-c windings, so combined with zig-zag connected d-c windings that an over-all 24-phase system is obtained. Current-limiting reactors are connected in series with each d-c winding, for limiting the fault current during an arc black or an arc through. The reactors are installed in the transformer tanks.

"The frequency changer consists of several duplicate rectifier groups. When power flows from the 60-cycle to the 25-cycle system, the rectifying elements on the 60-cycle side operate as power rectifiers, converting a-c power to d-c at 12,500 volts. The rectifying elements on the 25-cycle side operate as power inverters, converting the d-c power to a-c power into the 25-cycle system. Conversely, when the direction of power flow is from the 25 to the 60-cycle system, the 25-cycle rectifying elements operate as power rectifiers and the 60-cycle units as power inverters.

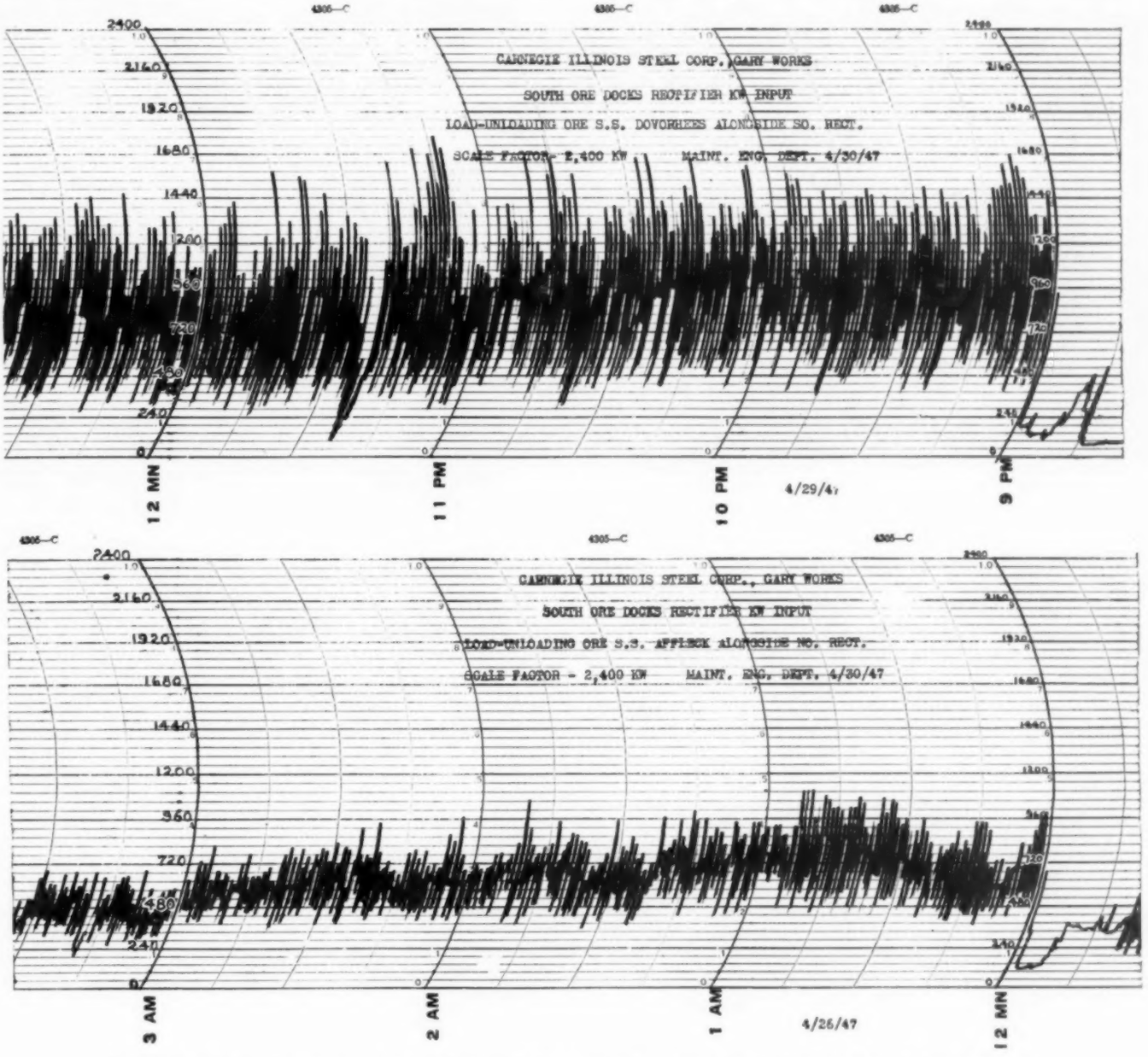
Power control—"The installation is designed for unattended operation, although an observer is usually present in the building. It is controlled from remote panels located in a 60-cycle power station several hundred feet away. The operator can close the main a-c

breakers to place the frequency changer in service, and can select one of several methods of power control, as follows:

A. Power flow continually in either direction.
B. Adjust the rate of power flow, which will be maintained automatically at the set value.
C. Set the frequency changer to maintain automatically a desired rate of purchased 60-cycle power, within limits. This may involve automatic reversal of power flow direction, depending on generation and consumption of 60-cycle power within the company's own 60-cycle system.

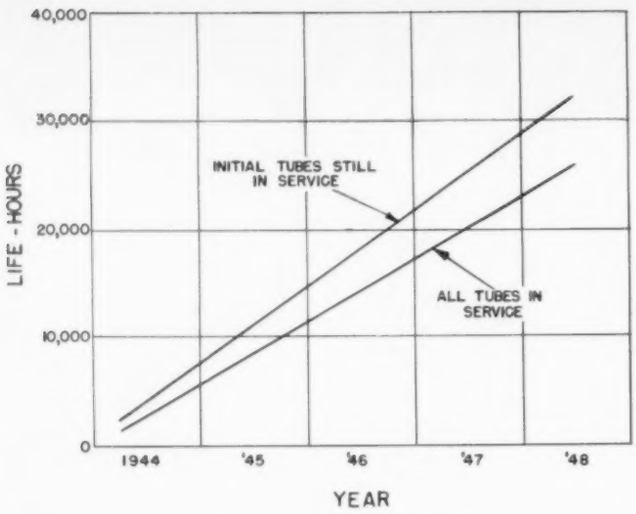
"The direction of power flow is established by the phase position of the supply voltages to the ignition and grid-control circuits, in relation to the transformer phase voltages of each rectifier. The change from one direction to the other is accomplished by means of contactors, operated by a master control.

"The power transmitted by the frequency changer is regulated by phase control on both the power rectifiers and the power inverters. The phase control is adjusted by means of saturable reactors in a phase-shifting network, which supplies the ignition and grid-control circuits of each rectifier group. A rotating regulator, controlled by the power regulator, supplies a variable direct current to the magnetizing windings of the saturable reactors. Each rectifier group is provided with a phase-shifting network and a rotating regulator. The voltages for the ignition and grid circuits of individual tubes in each group are obtained from the phase-shifting network through insulating transformers, because the tubes are insulated from each other.


CARNEGIE ILLINOIS STEEL CORP., GARY WORKS
SOUTH ORE DOCKS RECTIFIER KW INPUT
LOAD-UNLOADING ORE S.S. DOVORHEES ALONGSIDE SO. RECT.
SCALE FACTOR - 2,400 KW MAINT. ENG. DEPT. 4/30/47
12 MN
11 PM
10 PM
9 PM
4/29/47
CARNEGIE ILLINOIS STEEL CORP., GARY WORKS
SOUTH ORE DOCKS RECTIFIER KW INPUT
LOAD-UNLOADING ORE S.S. AFFLECK ALONGSIDE NO. RECT.
SCALE FACTOR - 2,400 KW MAINT. ENG. DEPT. 4/30/47
3 AM
2 AM
1 AM
12 MN
4/26/47

The load chart shows division of load between two 1000-kw rectifiers at ore yard of Gary Steel Works.

Protection—"Arc backs in the power rectifiers and arc throughs in the power inverters are interrupted by arc suppression, through grid and ignition controls, without tripping the a-c breakers.



Curve gives life of rectifier tubes in 20,000-kw electronic frequency changer.

"When a fault occurs, instantaneously-operated thyratron tubes and backup relays block the conductivity in all the ignitron tubes of the 10,000-kw unit involved, by stopping ignition and biasing the grids negative. The current rapidly falls to zero; normal excitation is then reestablished automatically, and the unit resumes normal operation within about one-quarter second from the occurrence of the fault.

"Protection for the rectifier transformers and backup protection for the tubes is provided by overcurrent relays, which are connected to current transformers in the a-c circuits and trip the oil circuit breakers.

Installation and operation — "The rectifier transformers and oil circuit breakers are installed outdoors. The rectifier tubes with their auxiliaries and control equipment are housed in a windowless, air-conditioned building, the first floor of which is located above the main transformers. This arrangement was used because the location is in a flood area, and because available ground space was limited. The rectifier tubes are enclosed in cubicles, on the second floor of the building. The control panels and the anode disconnects are installed on the lower floor. Each 10,000-kw unit has a recirculating cooling system, with a water-to-water heat exchanger, for cooling the ignitron tubes.

"The over-all efficiency of the Edgar Thomson frequency changer exceeds 90 to 93 per cent under most operating conditions. The power factor of the power rectifiers ranges between 85 and 95 per cent, and for the power inverters is between 75 and 75 per cent, depending upon the load and a-c system conditions.

"The frequency changer operates usually in the 60-cycle to 25-cycle direction, but there have been instances when operation in the other direction was necessary. During some periods of power shortage on the 25-cycle system in the past year, the converter was required to deliver power continuously at considerably above its full-load rating, and it performed successfully.

"Life of the pentode ignitrons have exceeded expectations, and a majority of the original tubes are still in service. Most of the problems in this installation have been those of making correct adjustments of the automatic phase control and temperature-regulating equipments. Before achieving the final correct adjustments, the frequency of faults was greater than desired by the designing engineers, but not excessive from an operating standpoint. A goal of not more than ten faults per day (24 hours) was set by the designers. This was eventually bettered, and under these conditions operation can be considered highly successful."

Both these electronic frequency changers were installed during the war, and manufacturing details were often governed by available materials and engineering expediencies. Since the war many improvements have been made to circuits and tube designs, so that the past operation records are not comparable to expected normal life.

During the first three years of service there were twenty-seven tubes removed in the Edgar Thomson units out of a possible forty-eight. During 1946 and 1947 only five were changed and for the past three months, there have been no changes.

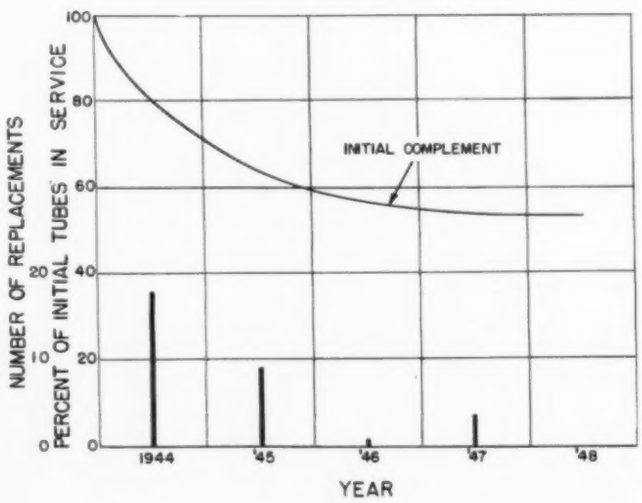
Some of these tubes were repaired and placed back in service so that at the present time there are twenty-five of the original tubes in the units.

For the past year, one unit which had a good record with few outages is now out of service for changes to increase its normal capacity to 8,000-kw and to install the second unit.

Summarizing the operation of our rectifier units, it can be said that practically all of the troubles have occurred during the initial periods of operations. Further, many of these can be attributed to the war time materials and workmanship. After these difficulties were overcome they have required no special care other than routine inspections and minor adjustments. We are anxious to learn the probable life of the tanks, but a maximum of seven years of service has not necessitated any major rebuilds.

We have been very well satisfied with the performance of this type of conversion equipment and anticipate an expanded use of same in the future.

Curve gives number of original tubes still in service of 20,000-kw electronic frequency changer.



DISCUSSION

PRESENTED BY

W. B. SNYDER, Steel Mill Division, Industrial Engineering Divisions, General Electric Co., Schenectady, N. Y.

W. R. HARRIS, Manager, Metal Working Section, Industry Engineering Department, Westinghouse Electric Corp., East Pittsburgh, Pa.

HARRY ANGEL, Electrical Engineer, Construction Engineering Department, Bethlehem Steel Co., Bethlehem, Pa.

J. D. O'ROARK, Electrical Superintendent, Weirton Steel Co., Weirton, W. Va.

FRANK W. CRAMER, Electrical Engineer, Carnegie-Illinois Steel Corp., Pittsburgh, Pa.

W. B. Snyder: Mr. Cramer's review of the Carnegie-Illinois Steel Corp.'s experience with mercury arc rectifiers is very valuable, in giving to the industry as a whole the results obtained by its largest rectifier user. It is interesting to see that this experience in general parallels that of users in other industries. The conclusion to be drawn is that the rectifier is a flexible, efficient and reliable machine, and that any troubles are likely to occur when the rectifier is first put into service, and can be corrected without too much difficulty.

The service records of the sealed rectifier tubes are also valuable, and it is to be hoped that Mr. Cramer and other users will continue to give us the benefit of their subsequent experience with these tubes. In this connection Mr. Cramer has also mentioned studies of 250-volt, d-c load concentrations, which resulted in a decision to use small sealed tube rectifiers at the load centers. Studies of this type will often show a very appreciable saving in installed cost as well as improved voltage regulation by using small units at the load centers rather than large units in one or two locations. This is becoming more widely appreciated, as may be seen from the large number of small sealed rectifiers already installed. For example, we have supplied or have on order some fifty-six 250-volt rectifiers totalling about 40,000-kw in the steel and allied industries. Thirty-one of these units, totalling over 11,000-kw, are of the sealed type in sizes of 500-kw or below.

Mr. Cramer has fully covered the use of mercury arc rectifiers for 250-volt constant potential supply and for frequency converter service. It appears that the latter application is no longer in the experimental class, and has become an approved means for joining systems of varying frequency.

No mention has been made of the use of rectifiers for supplying main-roll drive motors. This is a fairly new field in this country, as rectifiers have only recently become commercially competitive with motor-generators for this service. However, a few installations have been made, and the field promises to expand rapidly. We have at present two main-roll drive rectifier equipments installed and three others on order. The first installation consists of two 3500-kw, 600 volt, rectifiers augmenting the power supply of a hot strip mill bus. These are essentially constant voltage machines, having phase retard control only for voltage regulating purposes, and a small d-c voltage range by transformer tap adjustment. The second installation is a 300-kw, 300-volt sealed ignitron rectifier supplying a flanging machine drive. This equipment has full phase retard control to cover a motor speed range from zero to the maximum value, and to permit acceleration during rolling. At present this type of operation seems justified only on small units.

Two of the equipments now on order consist of one 1500-kw, and one 3500-kw, 600 volt, rectifier for supplying continuous tube mills. These have full phase control for starting duty only, and 40 per cent phase control for continuous operation. Mill operation below normal voltage is not contemplated at present, so it is probable that continuous phase control will be used only for experimental purposes.

The other equipment on order consists of two 5000-kw, 600-volt, rectifiers to serve as the sole supply of a hot strip mill finishing train bus. These rectifiers are arranged for full phase control for starting and 25 per cent for continuous operation.

W. R. Harris: The rectifier installations described by Mr. Cramer are all for auxiliary d-c power supply. Serious consideration has also been given to rectifiers as a power supply for merchant mills, hot strip mills and the like where except for starting conditions and occasional adjustment, constant potential d-c is required. We have a 2500-kw, ignitron unit in service on a merchant mill at Kaiser Co., Inc., at Fontana, Calif., and equipment for a hot strip mill in France now being manufactured will have three 5000-kw ignitron rectifiers for furnishing direct current power to six finishing stand motors totalling 23,000-hp. As compared to synchronous motor-generator sets, rectifiers have higher efficiency, particularly at light loads, are quiet in operation, and do not require heavy foundations. As time goes on, we will probably see greater use of rectifiers on main roll drives and operation of the units which my company and others will place in operation in the near future will be watched with interest.

Harry Angel: At the Sparrows Point plant of the Bethlehem Steel Co. in 1941 they installed the first mercury arc rectifier, which was a 1000-kw, 250-volt unit, and aside from a little bit of trouble the first month or so with the heat exchanger pump and the water they were using, this installation has turned out to be very successful. I do not think the unit is shut down more than once every three or four months to overhaul the heat exchanger.

In 1946 a similar 1000-kw unit at 60 cycles, the first one being on 25, was installed in a cold sheet mill, and this has been very gratifying in its performance.

I might say that both of these installations cover different parts of the plants, operating in parallel with existing equipment. The first installation was made under the trestle at a new blast furnace, and this rectifier supplies power to the blast furnace and also to the ore unloaders and ore bridges; the 250-volt power feed to these ore bridges normally comes from rotary converters in the powerhouse. Operating the rectifier in parallel with these machines is no problem at all. A

1500-kw unit was also installed in 1946 in a new hot strip mill.

I believe that another 1000-kw or 1500-kw unit is now on order for a different part of the plant, and at one of the other plants of the Bethlehem Steel Co., two 750-kw rectifiers have been operating in parallel since 1942 on wire block service. I do not believe they have done anything to the units except to wipe off the dust periodically and check the cooling. I believe everybody has been very well satisfied with the results.

In conclusion, I would like to say that the use of motor-generator sets these days is limited, and the mercury arc rectifier is with us to stay.

J. D. O'Roark: I would like to ask Mr. Cramer whether or not in their various rectifier installations they considered using anode breakers, that is, in the lead to the individual tank, so that in the case of arc back, they only trip out one tank.

The second question is: In applying rectifiers to open hearth service, do you have any other parallel source of supply, or do you depend on the rectifier alone to furnish power to your open hearth?

The third question is: What type of heat exchanger have they found least troublesome, that is, water to water or water to air, or do they have any particular preference, or does it depend on the conditions surrounding the installation?

Frank W. Cramer: On anode breakers, our installations are usually single units and anode breakers are not required. All our installations have water-to-water heat exchangers. The problem we had was to try to use Monongahela River water in these heat exchangers. This water contains too many solids and soon plugs up the tubes.

Out in the Chicago district, where Lake Michigan water is used, everything is very satisfactory, but in the Pittsburgh district we have to use what they call "city water" in the heat exchanger.

Referring to open hearth installations, I think all our open hearth installations, whether they are rectifiers, rotaries or motor-generator sets, have two sources of direct current power.

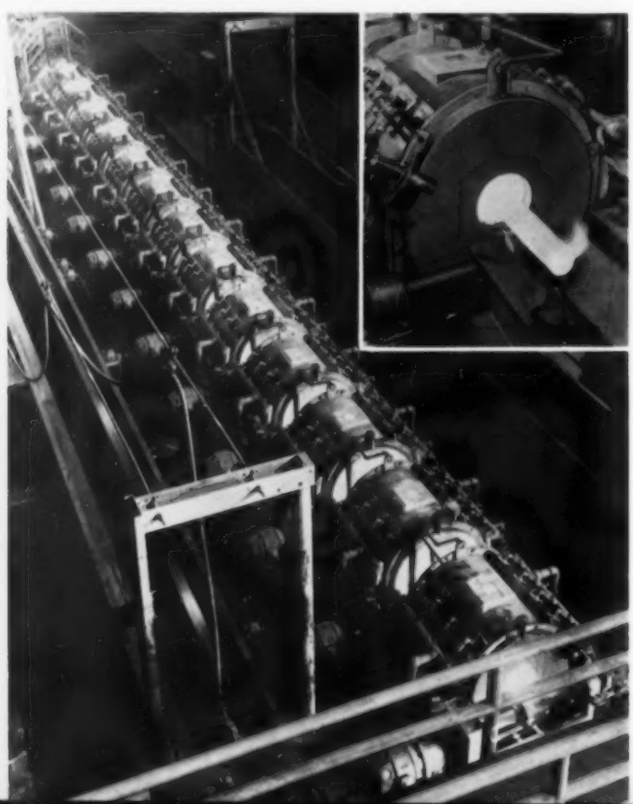
Another point of interest that was not mentioned in the paper, is the short circuit contribution of rectifiers. If you are interested in short circuit studies, you will find the contribution from a mercury arc rectifier is very much less than from a synchronous machine.

There is another point I would like to bring out which was not mentioned in the paper. These little 500-kw sealed tube units come in packages. The unit is practically all wired up and they can be set almost anywhere. There is very little wiring to do. You can set them on the floor if the floor happens to be level, and they are a very convenient equipment to install. If you place them near your load centers, 500-kw will furnish power to a lot of cranes and you eliminate a lot of d-c transmission lines.

In closing it is my opinion—and several of the speakers this morning have mentioned the same thing—that mercury arc rectifiers are the coming source of power for our d-c auxiliary drives and also for the main-roll drives.

NATIONAL TUBE INSTALLS NEW HEATING FURNACES

▲ Thirteen new doughnut-shaped furnaces have been installed in National Tube Co.'s Gary, Ind., mill to heat pierced seamless steel tubes to high enough temperature so they can be rolled to specified size. Tube sections go through the holes at speeds from 15—240 fpm, emerging at the end, ready for rolling, at 1800 F. Temperature control is exercised in two ways, by adjusting the temperature of each succeeding furnace unit and by the speed or delay of transit of tube sections through the units.



Lined with heat-resistant refractory material and fed by gas premixed with air in special generators, the furnace units stand about a foot apart in six groups, their circular openings in a continuous row. The hole in each "doughnut" is approximately 1½ ft in diameter and 3½ ft thick. Roller conveyors between the furnaces bring up each tube separately, whisking it through the heating chamber to the next conveyor.

Twenty radiation pyrometers regulate each furnace unit at its fuel supply. At the same time a series of electric eyes regulate the speed of the tube's transit through the groups of furnaces by regulating the conveyor speed, providing a longer heating period when needed or shortening it if the tube is already very hot.

These furnaces are constructed to accommodate tubes up to 45 ft long and 3 to 9 in. outside diameter. They are designed to heat for final sizing all types of alloy, stainless and carbon steel specialty tubing (both mechanical and pressure). The doughnut-type furnaces are used in conjunction with a huge rotary billet heating furnace. Other new facilities under construction or definitely planned at this U. S. Steel mill include an additional seamless tube mill of advanced type.

Unfinished seamless steel tubing passes through line of 13 reheating furnaces at National Tube Company's Gary, Ind., mill. Speed of steel through the line is adjustable. Electric eyes (on left of heated tube in inset photograph) adjust temperature automatically at each unit.

THE REVERSING CLUSTER MILL

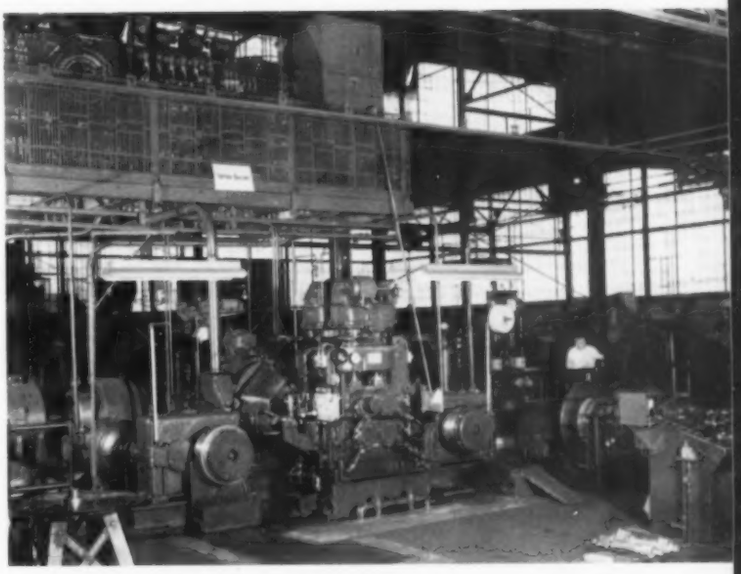
. . . . the cluster mill enables the operator to obtain the larger reductions afforded by small work rolls and at the same time retain the greater rigidity inherent in larger rolls . . . .

By G. E. FARRINGTON
Chief Engineer
E. W. Bliss Co.
Salem, Ohio

▲ FOR many years, designers of rolling mills for strips and sheets have sought to build a cold reducing mill that would closely approach correct and uniform gage, and also make substantial reductions at highest practical speeds. During the time of the two-high sheet mill, when the physical design of the mill and roll neck bearings required large sturdy necks, the search for accuracy of gage was directed toward the rolls having a surface profile suitable under normal working conditions. These conditions arise from the result of temperature variations along the rolls, and the deflection of the rolls themselves under load. This method soon reached its limits and the rolling efficiency, as well as the tonnages of these mills were necessarily very low.

The rolling mill engineer, in seeking to improve overall efficiency and accuracy, developed the three-high, four-high, cluster, and Y-mills. As the anti-friction bearings developed, these mills as well as the two-high mill have been brought close to their maximum efficiency, speeds, and accuracy by design changes in the rolls and roll neck bearings. Correct and uniform gage of strip on all these types of mills is now limited to the profile of the roll body and rigidity of the mill, such as stretch in the housing, deflection of the rolls both vertically and horizontally, and movement of the bearings themselves.

It has been discussed and proven by many authorities and designers of rolling mills, that the smaller the work roll diameter, the more accurate and efficient becomes the rolling of the material. To get the maximum from these findings, the roll diameters for various roll schedules and materials, should be selected as small as the required gripping capacity or bite of the rolls will permit. This ultimate may not be too practical if speed and tonnage are desirable. The more uniform thickness of the rolled material over its width and length is the result of the reduction in roll flattening at the pressure point with decreasing roll diameter. The ratio of the thickness of the strip on the delivery side of the mill, to the work roll diameter, determines the deformation efficiency. Therefore, efficiency increases with decreasing roll diameter. As everyone knows, because of the fact that small diameter work rolls can make greater



The work rolls of this cluster mill are 3¼ in. in diameter and 8 in. long. A work roll assembly is on the floor in front of the operator's bench. The backup rolls, of which one top and one bottom are driven, are 10 in. x 8 in. long.

overall reductions without intermediate annealing, the rolling mill engineer and manufacturer attempt to use as small rolls as is physically practical.

The relation of the roll diameter to compressive resistance, forward slip and spread is fairly uniform. With roll diameters of 6 in. and greater, compressive resistance (rolling pressure divided by the area of the compressed strip) increases rapidly up to 10 per cent reduction and rises still more with heavy reductions up to 50 per cent, although the rate of rise tapers off. On small roll diameters of approximately 3 in., the compressive resistance is much lower, and passes through a maximum at about 25 per cent reduction. The forward slip with the large diameter rolls, increases fairly regularly with the rising per cent of reduction.

The spread in the strip when using small rolls increases with increase in per cent reduction up to approximately 50 per cent, at which point the spread becomes maximum. Roll diameters of approximately 6 in. and larger show still increasing spread at 60 per cent reduction for the reason that the increase in compres-

Presented before AISE Cleveland District Section Meeting at Cleveland, Ohio on April 19, 1948 and at Youngstown, Ohio, April 20, 1948.

sed length of metal due to roll flattening along the lengthwise direction of strip causes an increase in the resistance to flow in the direction of rolling, and therefore the material flows to the sides, or spreads. These factors reflect themselves in the accuracy of gage and greater reductions possible with small diameter work rolls.

Tests run to show the relationship between roll pressure and roll diameters is proof that roll efficiency generally rises when the heaviest reduction possible is taken on the smallest diameter of work rolls. Practically, this cannot be done, as mills must be designed for various reductions and because the surface required on the finished strip must be taken into consideration.

The cluster mill has been designed to use as small work rolls as practical and still maintain rigidity of gage. Due to the fact that the housing windows are very short and the separating force or rolling pressure light, the stretch that exists in the housings when taking maximum reductions is held to a minimum. The fundamental design of the cluster mill is to provide means for maintaining an approximate 90 degree angle from the center of the small work roll and the two large backup rolls. The 90 degree angle between the rolls in both the top and bottom sections of the mill is essential to good operation as it divides the imparted load equally between the backup rolls. Each backup roll carries 50 per cent of the load on the work roll, thereby increasing the capacity of the mill. In addition to this increased capacity, the two top or bottom backing rolls form a nest or cradle for the small work roll, thereby guiding or preventing deflection either horizontally or vertically up to the capacity of the backing rolls. For instance, it would require a 6 in. diameter work roll in a conventional four-high mill to be as stiff horizontally on an 8 in. wide mill as the 3 in. diameter roll nested in the cradle of the 10 in. diameter backup rolls. The above mentioned increase in capacity without the use of larger rolls is beneficial from both a cost and operational standpoint. Smaller rolls are easier to change than heavy ones and require less handling equipment for the mill and crane.

The two top and two bottom backup roll assemblies are formed with two chocks and two rolls. The operator's side chock is one piece as is the drive side, and this chock is designed to withstand the mill separating force vertically and the spreading force horizontally.

Assuming a separating force of 100,000 lb, the vertical load on each work roll is 100,000 lb, and since the angle is approximately 90 degrees from the backup roll to work roll to backup roll, each backup roll must withstand 70 per cent or 70,000 lb. This load is equally divided horizontally and vertically, thus each of the two top or two bottom backup rolls are loaded to 50,000 lb in a vertical and 50,000 lb in a horizontal direction. Backup roll deflection along the 45 degree angle to the pass is therefore 70 per cent of that in a four-high mill of comparable dimensions. By decreasing the included angle of 90 degrees, the load can be further reduced, but at the expense of lateral stability of the work roll and physical limitation of the minimum size of the work roll.

The work roll bearings and chocks carry no thrust load other than that applied from the action of the spindles or misalinement of the material in the mill. The top backup chock assembly is adjustable under each pair of screws by means of a hand operated wedge, which after once being set, requires no further adjustment. The bottom backup chocks are not adjustable and firmly rest on the housing rocker plate and against the sides of the housing windows.

The particular mill under discussion is slightly different than most cluster mills built, in that one top and one bottom backup roll is driven instead of the conventional work roll drive. The separating force available with the cluster mill of this size computed into torque is sufficiently great to over-stress the work roll necks and therefore the backup rolls are driven.

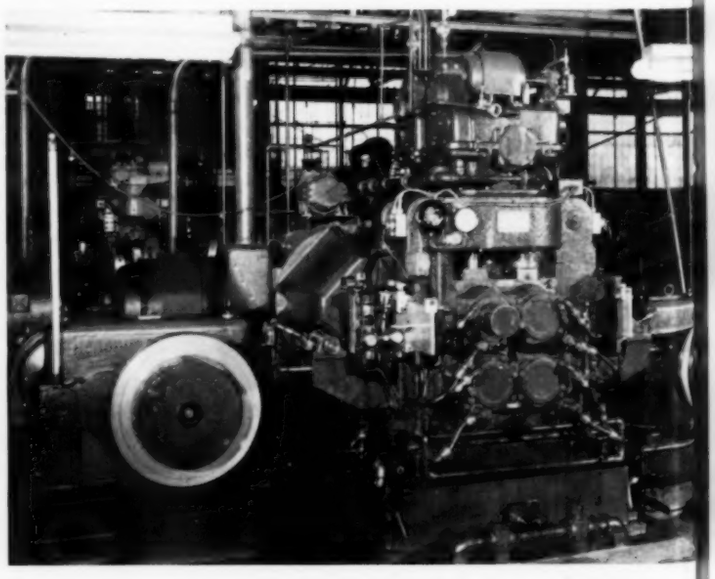
A standard pinion stand design is used with the pinions located on centers that match the backing roll centers instead of work roll centers. The peripheral speed of the backup rolls is the same as the work rolls, but since their diameter is greater, a larger gear reduction must be used to attain the desired speed. Spindles are equipped with universal joints to allow for changes in roll centers as is done conventionally. The work rolls need not be perfectly matched in diameter as they are surface driven, but the two driven backup rolls require the same tolerances as normally would be used on work rolls. But as there are four backup rolls, the problem of matching diameters is greatly reduced.

This arrangement permits the use of short work rolls and easily handled work roll assemblies.

Work rolls with their chocks are, in this mill, removed manually. The chocks are equipped with bearings having a high thrust capacity and small radial rating. This thrust capacity is used in the same manner as on a four or two-high mill and only sufficient radial capacity is required for roll balance. Backup chocks are removed in pairs, that is, two top rolls with their two double chocks are removed as a unit by means of a C-hook arrangement. The same method is used on the bottom.

Spring pressure is used in the usual manner to separate the top and bottom backup roll assemblies and take out the slack or looseness that could develop between the screws and chocks. The work rolls are separated by another set of coil springs to insure contact with the backup rolls when material is not in the mill. As the

Stainless steel is rolled on this 3¼ in. and 10 in. x 8 in. cluster mill.



only friction to overcome is that in the bearings, a small pressure is sufficient.

The screwdown is of the conventional type used on two or four-high mills with the addition of another screw on each side. The pair of screws on each chock is connected through gearing to a 3-hp high torque motor, and the two pairs are connected through a magnetic clutch. The two screws on each side of the mill operate together and cannot be separated. The misalinement that might occur between them is corrected by the hand adjusted wedge under one screw as mentioned before. Each pair can be independently operated or both pairs of screws can operate together as is done on most four-high mills.

The drive is a conventional reduction unit and powered by a 100-hp, 575/1150-rpm motor under Ward-Leonard control, giving a maximum speed of 300 fpm. All bearings are anti-friction type, and gears are double helical, giving strength and quiet operation.

The two tension reels are of wedge type design and equipped with jaws for gripping the strip. The blocks are collapsed and expanded by means of rotating air cylinders mounted on the back end of the reel shaft, and no thrust from these cylinders is imparted to the drive bearings, as the block and cylinder are connected as a unit. The jaw opens and closes automatically as the block collapses and expands. The tension reel drive is of simplified design and each is driven by a 10-hp, 350/1300-rpm motor connected to the same power source as the main drive motor. A coil build-up of over three to one is possible with constant tension throughout the entire running of the coil.

One reel only is equipped with a buggy and stripper, as it was felt at the time that all coils would be loaded and unloaded on one side of the mill. At the present time, a second buggy is under consideration. The coil car or buggy uses a reversing 2-hp, 1200 rpm motor driving a pump for raising and lowering the coil. A solenoid two-way valve is connected in parallel to the pump motor and is normally closed, preventing the hoist from lowering from a preset position. The two-way valve is connected in parallel and opens whenever current is applied to the pump motor. When raising the hoist, the valve opens and at the breaking of the electrical circuit, the valve closes and the motor stops. The same operation takes place when lowering, giving a simple and trouble-free system.

The work roll bearings are anti-friction and oil-flooded bearings are used in the backup rolls. As these bearings are rated at 130,000 lb per neck or 520,000 lb for four, the mill capacity is 70 per cent of this figure or 364,000 lb. This is equivalent to 45,500 lb per inch of width which is high for an 8 in. wide mill having 3½ in. diameter rolls.

The strip lubrication system is built into the reel and drive bases, eliminating the necessity of adding tanks for the coolant. Two coolant systems are in use today. One is used mainly for coolant with a small amount of lubricant for the strip, and the other is mainly lubricant. A simply juggling of valves can direct either one at any time at the operator's discretion.

A lubrication system supplies oil for the backup roll bearings and all anti-friction bearings are greased from a central automatic system.

Screwdowns are self-lubricated and the drive and pinion stand are force-lubricated with a pressure switch to insure flow of lubricant.

This cluster mill has been in steady operation for a six months period and aside from the usual initial operating adjustments has been giving exceptionally good performance. It is used in the finishing of high grade stainless steel and produces gages as low as 0.006 in. up to 6 in. wide. It has also done roughing work, starting with carbon and stainless steels as thick as 0.250 in. Wear on the backup rolls is slightly greater than on similar mills having their work rolls driven, but to date no comparison has been made as the work roll drive mills are not doing the amount of work on the same material due to the limit of torque applicable. We feel the cluster mill has a very definite place in the ferrous and non-ferrous industry, and while it is not a cure-all and is not supposed to outdate all other mills, it has a particular niche where it functions better than the two or four-high mill.

WANTED!

There is a constant demand for copies of "The Modern Strip Mill", published by the Association of Iron and Steel Engineers. If your copy is not in use please get in touch with us.

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STEAM GENERATION AND MAINTENANCE OF POWER STATIONS FOR STEEL PLANTS

. . . . maintenance scheduling for power plant equipment can usually be so set up that equipment will be out of service for maintenance at periods of light power consumption . . . .

By JOHN J. ALEXANDER
Assistant Superintendent
Power Department
Republic Steel Corp.
Cleveland, Ohio

▲ THE operation of steam generating stations for steel plants is extremely variable. Anticipation of steam demand from one hour to the next cannot be accurately predicted. The explanation for the variation in steam demand is quite obvious. Steam is used from coke plant through all steel producing departments to strip mill finishing process in large quantities. It may be of interest to discuss the operation of several steam generating stations interconnected by a distributing system which serves a complex steel mill operation.

Figure 1 shows the schematic arrangement of the steam generating and distributing facilities:

1. The main power station boiler plant consists of fourteen blast furnace gas fired boilers with oil for auxiliary fuel. One coal stoker fired boiler is normally on cold standby service. With four blast furnaces in operation, ample blast furnace gas is available for production of 590,000 lb of steam per hour without use of fuel oil except during blast furnace stops.

2. The old power station has nine gas fired boilers with eight of these normally in service to produce about 96,000 lb per hr of 150 psi saturated steam.

3. The RFC power station has two blast furnace gas fired boilers with pulverized coal for auxiliary fuel to produce approximately 350,000 lb per hr of steam.

4. Twelve waste heat boilers are usually in operation to provide 150,000 lb per hr of steam to the system.

5. Three braize fired and two coal fired boilers are normally required with peak load steam demands to produce 150,000 lb per hr of steam from the blooming mill boiler house.

If the steam demand on this system was stable and blast furnace production was uninterrupted, operation of the steam generating units would be comparatively simple. Unfortunately steam demand varies from 1,400,000 lb per hr peaks to 600,000 lb per hr minimum demands with normal operation. Blast furnace gas supply varies from 17,900,000 cfhr with five furnaces operating to about 8,500,000 cfhr when two furnaces are interrupted simultaneously. It is evident that careful operation is necessary if steam requirements are to be supplied with reasonable fuel costs. The purpose of this paper is to discuss the operation of this steam generating system and the maintenance of the equipment. Although we have not reached a "millennium" either in operation or maintenance, it is possible that discussion may aid in improving these services essential to steel mill operation.

At weekly intervals the mill operation for the ensuing week is considered and a tentative schedule for operation of the steam generating units is issued. Obviously, boiler operation is arranged to utilize the maximum waste heat available in gas from open hearth and blast furnaces. A normal weekly schedule would provide for operation of fourteen gas fired boilers in the main power station, three gas fired boilers in the old powerhouse, two gas fired at the RFC powerhouse, and twelve waste heat boilers at the open hearth during periods of reduced mill operation when steam demand is lowest. When mill operation is increased, three braize boilers at the blooming mill boiler house are placed in service, and coal is used as auxiliary fuel to increase output of the RFC boilers. During peak steam demand periods, coal stoker fired boilers at the blooming mill boiler house are operated, and if additional gas fired boilers are placed in service in the old boiler house, fuel oil is used to supplement gas firing of boilers in the main power station.

A tentative schedule for boiler operation can only be an outline for actual operation. Any one of many operation conditions can require an immediate change in operation of the steam generating units. If a blast furnace is shut down, it is essential that steam generation be maintained equal to demand and that immediate steps be taken to generate the steam with use of the most economical fuel, consistent with safe operation. For this reason it is imperative that all steam generating facilities have centralized authority for all boiler operation twenty-four hours each day and that the operating personnel be well trained to alter operating conditions to meet any change in steam requirements.

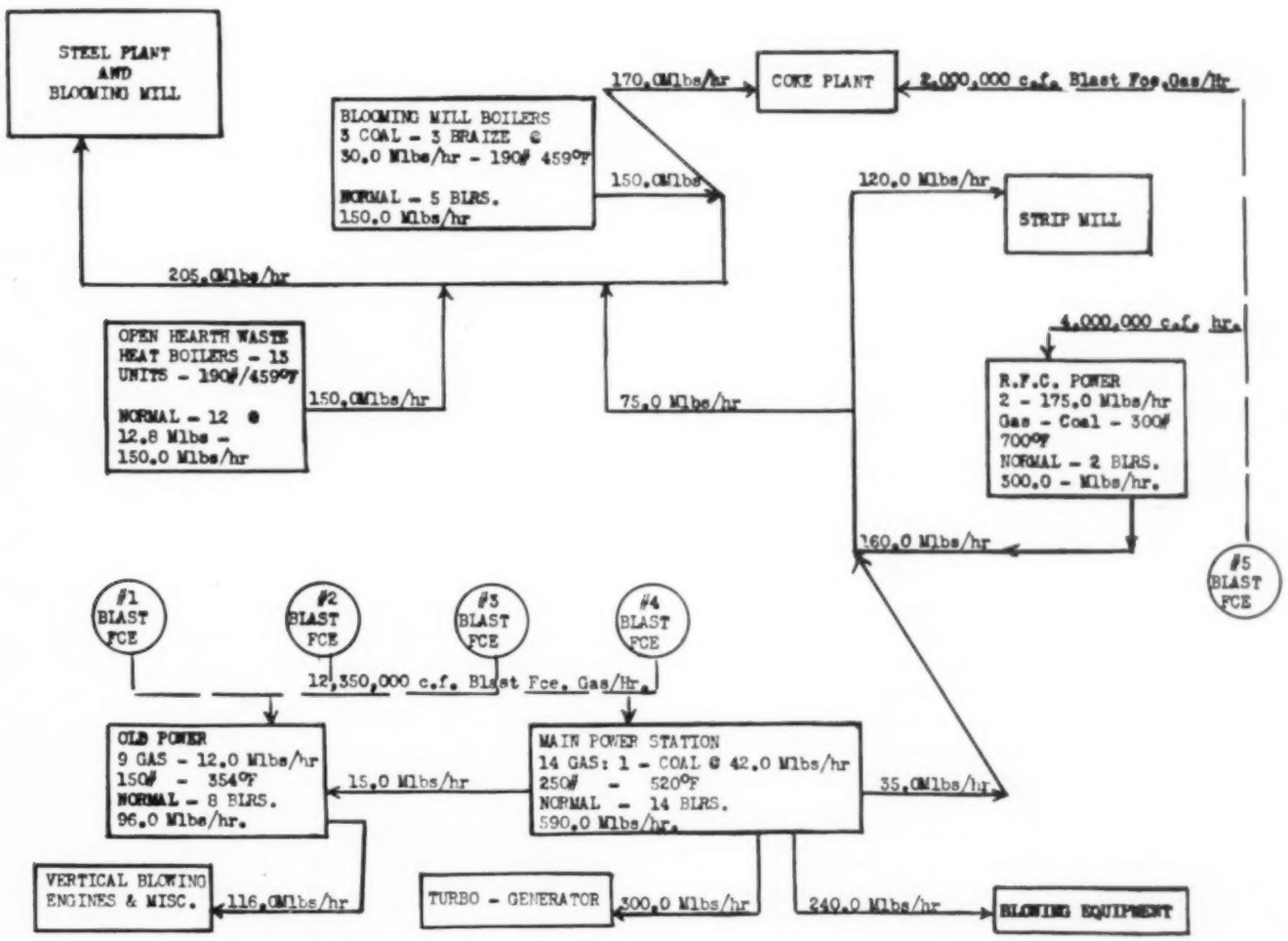
Presented before AISE Annual Convention, Pittsburgh, Pa., September 23, 1947

Each of the major steam producing units is directed by an operating engineer. The engineer in charge of the main power station determines the steam requirements to be placed on each of the other stations by intelligent consideration of steam demand due to electric power and blowing engine requirements. The engineer in charge of the various stations are normally men of five to ten years service with sufficient training and experience to obtain state licenses. The engineer in the main power station must have experience on approximately twenty different positions at the various power stations and as a rule has about fifteen years experience. Obviously, long range planning is required to properly fill key positions so that steam generating equipment is operated safely and economically.

We consider it essential to have both operation and maintenance of steam generating and major steam consuming equipment directed by the same supervision. One reason for this is to permit the coordination of maintenance schedule for the equipment with the operation requirements for the equipment. Each boiler is normally scheduled for at least one outage a year for internal inspection, cleaning of tubes and repair of refractory. With proper control of boiler feed water no great difficulty is experienced in maintaining boiler efficiency relatively high for a period of approximately fifty-one weeks. Annual overhaul and inspection usually requires approximately one week. It is quite evident that careful judgment must be exercised to schedule outage periods of the largest steam generating units when steam demand is somewhat less than maximum. A period of reduced mill operation or blast furnace outage is usually selected and frequently is chosen without advance notice when some operating trouble is experienced in a production department. For this reason we have found it very desirable to maintain a small force of skilled repairmen employed normally in routine maintenance of equipment in the various power stations. When major equipment is down for overhaul it is possible to concentrate most of this group of men to the job without competing with production department requirements for performance of mechanical work.

I do not intend to imply that equipment maintenance is not scheduled. From Figure 2 you will note the type chart we use to schedule and record the overhaul and inspection date for all major steam driven equipment. For clarity a section of this chart only has been selected. You will note that a blank circle is used to indicate the month that equipment is scheduled for annual inspection. When the inspection is made, the blank circle is filled to indicate that unit was completely overhauled. Where partial inspections, such as

Figure 1 — Arrangement of steam generating and distribution facilities at Republic Steel Corporation's Cleveland plant.



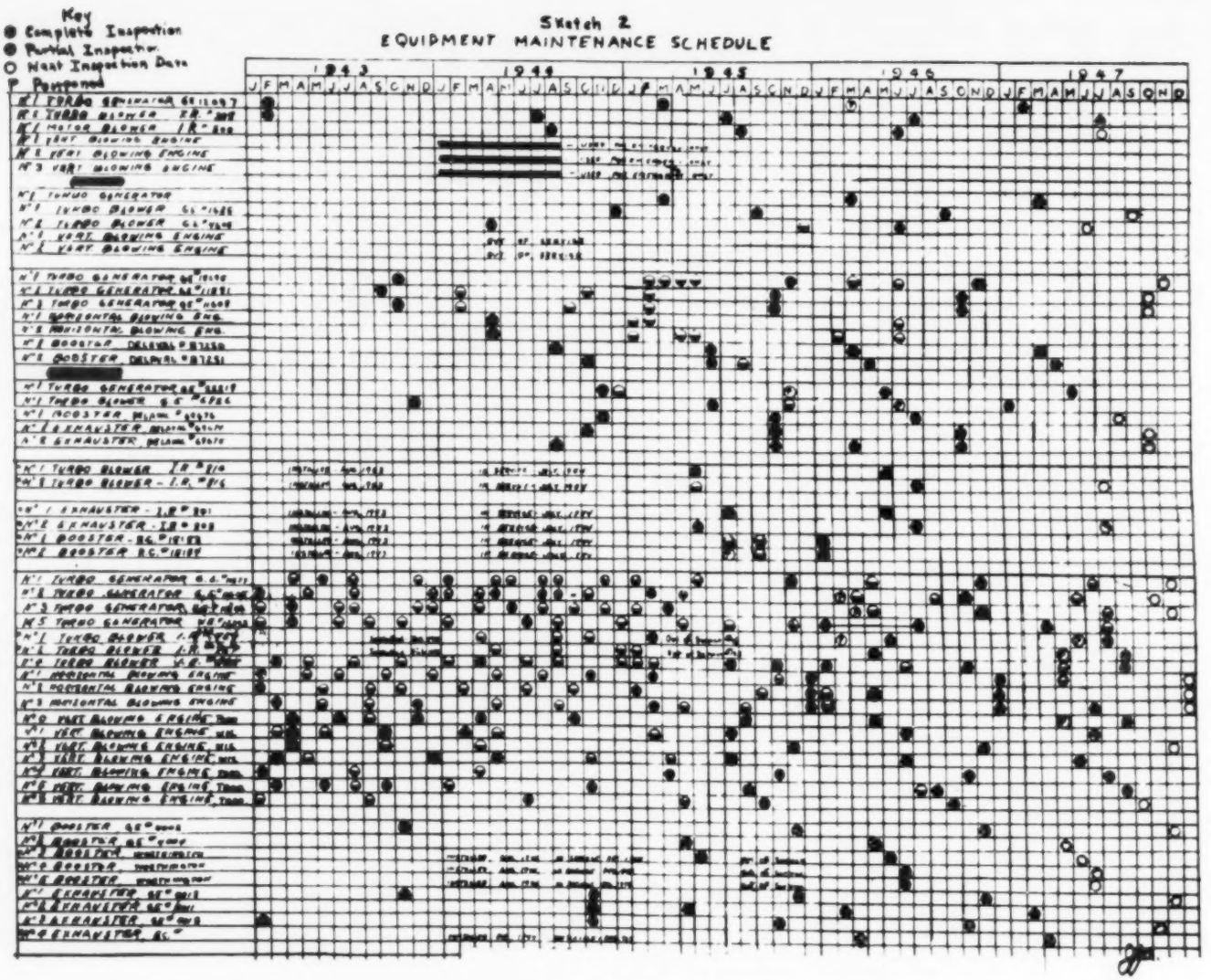

Key
● Complete Inspection
◐ Partial Inspection
○ Next Inspection Date
P Postponed
Sketch 2
EQUIPMENT MAINTENANCE SCHEDULE
1943
1944
1945
1946
1947
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D

Figure 2 — Equipment maintenance is scheduled on charts similar to the one shown.

examination of bearings, thrust bearing, valve gear, etc., are made this is indicated by the half-filled circle. Production departments are usually advised of scheduled inspections one month prior to the due date. It is usually possible to schedule an inspection at the same date that repairs are required by production department so that no loss is caused by the inspection. In cases where equipment operation is satisfactory and production loss would occur, the inspection is postponed and indicated by the letter P within the circle, and the deferred date of inspection is then entered on chart and must not be postponed a second time even though production loss is involved.

It may be well to discuss briefly what is implied by the indicated symbol "Complete Inspection." For an example we will select turbo-blower No. 2. Note the "Log of Annual Inspection" reads as follows:

Saturday—July 19—Recorded steam pressure of first stage, steam flow, absolute pressure of exhaust, inlet and discharge temperatures of condenser and condensing water, air flow, temperature, pressure and speed. Checked and recorded vibration of each of four bearings and control oil and bearing oil pressures.

Sunday—Machine out of service (not required for series operation of turbo-blowers due to shortage of coke for No. 5 blast furnace). Removed lagging from turbine and blower casing but left unit available for spare in case of emergency. Time required: four men—three hours=12 man-hours.

Monday—Removed nuts from studs on turbine casing and blower casing with impact wrench. Recorded clearances of all turbine blades—12 stages, clearances to nozzles on each side, taken and recorded. Removed cover from blower. Removed caps from all bearings and examined both plain and thrust bearings. Noted slight rub on No. 2 bearing, other three bearings quite clean and no evidence of wear. Recorded coupling alinement. Removed turbine spindle, examined blades, wheels and diaphragms. No appreciable deposit or erosion. Time required: nine men—with service engineer from manufacturer—eight hours=total for day of 80 man-hours.

Tuesday—Cleaned turbine casing and blower casing joints. Cleaned turbine blades and diaphragms with wet fly ash to polished metal surfaces. Magnaflux test of all blades, and wheels of the twelve stages on turbine spindle. No cracks or defects were found and all locking pieces were intact. Examined blower rotor. Recorded thickness of vanes and per cent wear of rivet heads. Recorded estimated life of vanes of each of impellors based upon erosion of preceding service. Made impres-

sions on sheet lead of vane tips to record exact condition for future comparison. Cleaned blower casing with compressed air. Removed covers from check valve. Inspected steam compartment of condenser. Examined lower half of all four bearings and scraped to improve clearance. Opened oil release notches to increase oil flow through No. 2 bearing. Time required: ten men—eight hours=total of 80 man-hours.

Wednesday—Replaced spindle and recorded clearances of all twelve stages. Replaced top section of blower casing. Replaced top half of steam cylinder. Pulled down both covers with use of impact wrench on nuts. Checked coupling alinement and recorded same. Inspected main oil pump. Inspected valve gear and assembled. Inspected overspeed and speed limit control devices. Cleaned check valve and inspected valves. Time required: nine men—eight hours=72 man-hours.

Thursday—Inspected auxiliary oil pump. Repaired sealing steam line, replaced all gaskets and overhauled pressure reducing valve. Inspected oil coolers, strainers and oil reservoir. Measured thickness of thrust blocks from both thrust bearings. Recorded total clearances of blower and turbine thrusts. Checked alinement of shaft extension for main oil pump and recorded pump worm gear backlash. Placed each bearing cap with fuse wire on journals to determine clearances. Recorded clearances of all bearings. Replaced covers and thermometers on all bearings. Pumped oil to reservoir through oil filter. Warmed up steam header, circulated oil and inspected for oil and steam leaks. Warmed up turbine casing with sealing steam. Pulled down all nuts with hand wrench after unit was heated. Brought up vacuum to 12 in. Hg and rolled turbine only at 1000 rpm for thirty minutes. Pulled down all turbine casing bolts. Ran overspeed tests on turbine and adjusted to trip at 3100 rpm—three successive trials. Adjusted speed limit governor to start valve closure at 2890 rpm and have all valves closed at 3000 rpm. Replaced lagging on blower casing. Replaced covers on air discharge check valve. Time required: eight men—eight hours or 64 man-hours.

Friday—Made up coupling. Replaced insulation and lagging on turbine casing. Adjusted sealing steam regulator. Checked performance of air volume regulator and inspected control lines. Ran unit to atmosphere for two hours. Placed unit in service on furnace. Recorded bearing temperature at fifteen minute intervals for four hours. Recorded vibration readings of all four bearings and all steam and air conditions noted before overhaul. Unit in service at 2:00 p.m. Friday. Replaced all tools, slings, cradles for spindles, etc. Time required: seven men—eight hours=a total of 56 hours for day. Total man-hours for overhaul and inspection of unit=384 man-hours.

The turbine throttle valve, condensate pumps and circulating water pumps had been inspected prior to this outage. This inspection of a turbo-blower was not made in unusual time. We have made similar inspections of this unit in about twenty-two hours when production loss was involved. The purpose of this detail is to show what is meant by "Annual Overhaul and Inspection" as indicated by the black dot on the chart.

There are several points about annual inspections of steam driven equipment that may be worthy of comment:

1. We have found it desirable to use a small group of mechanics, employed as power department repairmen, on this type job. These men are trained in the practice of dismantling and assembling of the turbines, blowers, engines and generators. This group is supplemented by a few men from our mechanical department. Considerable preparation is made prior to actual dismantling work. Repairmen have all necessary tools, such as slings, wrenches, sledges, blocks, and impact wrenches available. The men are assigned jobs in small groups and one repairman familiar with the work is employed as a lead man for each group. About four hours were required to remove nuts and lift a cover from a blower casing several years ago. We now have two men with an impact wrench remove nuts while three others place cable slings on crane hook and normally have the blower casing open in 45 to 50 minutes.

2. We consider it essential to have a service engineer from the equipment manufacturer on hand at all major inspections. We do not expect a service engineer to act as a construction foreman for the work since he is not usually familiar with the capabilities of the men employed on the job. The service engineer's duties are largely advisory and we accept suggestions on improving performance of unit or to speed inspection work. A foreman of the power department issues orders to men employed in actual mechanical work.

3. A written schedule of the work to be performed is normally issued in advance and copies are given to the department foreman, service engineer and operating engineers. This permits foremen to consider and assign various jobs for key repairmen prior to actual work. Operating personnel are advised of planned work and frequently will notice and report minor repair items that have been omitted.

4. Even though hourly readings of steam conditions, bearing temperature and pressures, etc., are normally recorded, it is customary to carefully observe all stated conditions and record this data with complete set of vibration readings before and following the inspection of each machine.

From Webster's dictionary, maintenance is described as "sustenance" or "means of support," while repair is defined as "mend" or "to restore after injury." If we apply these definitions to power station equipment in steel mills, I fear that we must conclude that our efforts are largely directed to repair work rather than equipment maintenance. Whether this is a costly practice or not must be determined from actual operation data. Unfortunately very few comprehensive maintenance programs have been observed to permit a comparison between repair and maintenance costs.

If we select the turbo-blower as an example, it is essential that the maintenance program be initiated when the equipment is installed. A complete record of both turbine and blower should be taken and carefully recorded as equipment is installed. Wheel clearances of both steam and air ends should be taken and recorded so they will be available for comparison at each inspection. The thrust bearing clearances and bearing journal conditions must be taken and recorded. It is essential that some provision be made to check the position of the turbine spindle and blower rotor to fixed external points of the machine. It should be possible to determine the thrust bearing clearances while the unit is in

Company _____

Plant _____

No. ___ Turbo - B lower Test

Date _____

Time				
Turbine Data:				
Steam Flow (Meter) M lbs/hr				
Steam Pressure, gage				
Steam Temperature, °F				
Steam Flow (Corrected) M lbs/hr				
Speed, Rev. Per. Minute				
First Stage Pressure, P.S.I. gage				
Third Stage Pressure, P.S.I. gage				
Fifth Stage Pressure, P.S.I. gage				
Seventh Stage Pressure,				
Exhaust Vacuum, Inches Hg.				
Barometer, Inches Hg.				
Exhaust Pressure, Inches Hg.				
Condensate Temperature, °F				
Inlet Water Temperature, °F				
Discharge Water Temperature, °F				
Blower Data:				
Air Volume, Corrected, C.F.M.				
Air Intake Temperature, °F				
Air Intake Pressure, Ins. H2O				
Relative Humidity, Percent				
First Stage Pressure, P.S.I. gage				
First Stage Temperature, °F				
Second Stage Pressure, P.S.I. gage				
Second Stage Temperature, °F				
Third Stage Pressure, P.S.I. gage				
Third Stage Temperature, °F				
Fourth Stage Pressure, P.S.I. gage				
Fourth Stage Temperature, °F				
Discharge Pressure, P.S.I. gage				
Discharge Temperature, °F				
Position Measurements:				
Turbine Spindle Position, Inches				
Blower Rotor Position, Inches				
Calculated Data:				
Steam Rate, lbs/M.C.F. of Air				
Steam Rate, corrected to 2" Abs.				
Turbine Exhaust and 20# Blast Pressure				

Figure 3 — Data sheet for recording turbo-blower tests.

normal service. A benchmark should be established and the relative elevations of several accessible points on both turbine and blower should be recorded by men that will be responsible for maintenance of the equipment.

The turbine and the blower should be equipped with instruments and gages that provide steam flow, pressure and temperature at turbine throttle. First stage and exhaust pressures should have appropriate indicating gages and the blower should be equipped with air volume indicating and recording meters, intake and discharge air temperature and pressure recording instruments. Test points should be provided to determine the temperature and pressure of air at each stage of the blower, and arrangements should be made so that test gages may be installed at four points on the turbine to determine steam pressure at four intermediate stages.

When the machine is assembled and ready for initial operation, performance tests should be made and all data carefully recorded. A log sheet similar to that shown in Figure 3 should provide a suitable means of recording the essential data. There are two advantages in conducting a complete set of performance tests at various loads on both turbine and blower: first, the operating personnel learns performance of equipment with respect to use of instruments as guides, and second, the normal stage pressures of turbine with known clearances and clean blades, and the blower stage pressures and temperatures with known conditions are established. These tests will also provide all concerned with complete information as to limitations of the equipment (pumping points at various pressures and flows, regulator performance, etc.) and will demonstrate that the equipment performance is equal to the manufacturers guarantee. The tests conducted during initial operation should be used as a gage and if similar data is taken at three month intervals with the unit in service, it is possible to approximate the internal condition of the equipment.

In a number of plants it is standard practice to operate a unit for one year and then open the turbine and blower. While there are many advantages to this practice, it is obvious that spare equipment must be installed to be operated during this period unless blast furnace production is reduced.

If internal conditions of the equipment cannot be ascertained, it is essential that the equipment be inspected at regular intervals to avoid costly delays and possibilities of wrecking the equipment. However, if the internal conditions of the equipment can be approximated from test data, the costly practice of dismantling equipment at yearly intervals might be discontinued. The possibility of damage to blading, labyrinth seals, etc., during dismantling or assembly work at these inspection periods cannot be ignored.

It is suggested that a well planned maintenance program with quarterly tests conducted on the equipment while in operation be substituted for annual dismantling of the equipment. This arrangement should permit a complete inspection and replacement of worn parts during each reline of the blast furnace.

Unfortunately, we frequently consider inspection and maintenance of the major units as being a complete maintenance program. Actually, a great many more mill delays, furnace slack wind periods, etc., are caused from faulty operation of minor auxiliary equipment than by failure of major units. We have found it necessary to schedule inspection of all auxiliary pumps, turbines, compressors, etc., for regular inspection similar to the arrangements used for major turbines. It is usually more feasible to inspect these units when major equipment is not being dismantled.

Routine maintenance of the auxiliary equipment is of the utmost importance to provide reliable operation of a power station. It is extremely difficult to have this work performed as scheduled. The need for miscellaneous repairs of other equipment frequently arises to interfere with routine inspection and adjustment of auxiliary equipment.

To insure the regular routine inspections we have found it necessary to resort to use of equipment maintenance reports, one example of which is shown in Figure 4. These forms are issued as minor inspections are required for blowing engines and turbo-generator auxiliary equipment. These sheets provide an excellent record when properly filled and are used to indicate use of spare parts. They are used to simplify ordering of replacement parts. You will note that the form is arranged for indicating the date that routine inspection is due. In case inspection cannot be made a due date, on account of operation requirements or due to more

essential work, the form is held by the repair foreman until completion is possible. This prevents repeated deferment of routine inspections and maintenance work on auxiliary equipment of the power station.

To establish a comprehensive maintenance program for a power station is a relatively simple task. To execute such a program properly is somewhat more difficult. Obviously the execution of a complete maintenance program requires considerable technical skill. Economically the employment of technically trained men to supervise this work can be justified in almost all power stations for steel plants.

Normally cost of fuel for steam generation is 85 to 90 per cent of the total cost of steam production. In a great many steam generating stations it is relatively simple to improve boiler efficiency 3 to 5 per cent for monthly operation by skilled manipulation of boiler combustion control, gas burner adjustments and routine maintenance of boiler appurtenances.

In the public utility power generation field it is standard practice to employ one or more trained men of each station concerned with plant betterment engineering. Performance and acceptance tests for new equipment are arranged and conducted by this group. The plant betterment engineer is responsible for adjustment of combustion control equipment and routine testing of turbo-generators and condensers to provide operation with performance of the units at optimum conditions. Equipment maintenance schedules and sheets are issued, checked and filed by this group. Instrument maintenance and water conditioning control is usually assigned to this group. Obviously this type of work is excellent training for younger technical men and a number of power station supervisors are given experience in this work.

It is my opinion that steam can be generated most economically and power station equipment maintained more efficiently if technically trained men are specifically assigned to this type of work in power stations for steel plants.

Figure 4 — Equipment maintenance report for turbine and auxiliary equipment.

Gr-1

EQUIPMENT MAINTENANCE REPORT

Equipment No. _____ Turbine and Auxiliary Equipment

Inspection Report Assigned to _____
Repairman

Date Inspection Due _____ Date Inspection Made _____

(1) What manifold valves were repacked? _____

Which valves were tightened? _____

Was valve gear inspected and cleaned? _____

(2) Were air pump, condensate pump, circulating pump and gear case, sealing and cooling lines cleaned? _____

(3) Were all auxiliary equipment couplings examined? _____

(4) Was governing mechanism on circulator and air pumps cleaned and inspected? _____

(5) Was thrust bearing on circulator inspected and found in good condition? _____

(6) Was air pump screen cleaned and river water line flushed out? _____

(7) Was equalizer line to condenser tailpipe clean and free? _____

(8) Was air washer cleaned and inspected? _____

How many nozzles were replaced? _____

Was screen in good condition? _____

REMARKS (List any minor repairs or adjustments made and any conditions noted that are not fully explained above.)

Signed _____
Repairman

Approved _____
Repair Foreman

For Office Use

Checked by _____

Date Filed _____

DISCUSSION

PRESENTED BY

JOHN J. ALEXANDER, Assistant Superintendent Power Department, Republic Steel Corp., Cleveland, Ohio

R. C. HUTCHISON, Bethlehem Steel Co., Bethlehem, Pa.

Member: The testing of turbines periodically is very fine, except that the cost of such tests, if you are going to do it in a thorough manner, and the time taken are often prohibitive.

The suggestion that stage pressures be taken at more than one point is worthwhile, because that gives a very definite indication of the internal condition of the machine. Those things are being done in many plants. The hourly readings are taken, but, very frankly, not much use is made of the data. It is possible to determine internal conditions by applying stage pressures against known loads and inlet pressures, providing the gages are accurate, and that you know the steam flow load, and so on, compared with the machine when it was new. In doing this, however, care must be taken that you do not get misled.

Mr. Alexander, in his log of the inspection, mentioned looking at the steam side of the condenser. No mention is made of the water side, whether or not the condenser was cleaned and the tubes cleaned at the same time. I suppose that was done. We are looking for 3 and 4 per cent improvement on boiler efficiency but often neglect a very important part of the equipment, and that is the surface condenser. Most steel mills have gone into that type of condensing unit, and tube cleanliness, of course, becomes a very important matter, and often the operators do not realize the effect of vacuum. There may be a difference of 2½ or 3 per cent in water rates, and frequently one goes into a plant and notes the vacuum down to 26 in. and nobody seems to be much concerned about it.

There are devices now available on modern condensing equipment which makes it possible to clean one-half of the condenser while the other half is in service, with some drop in vacuum in such things as the reverse

flow valve so you can reverse the flow of the water and thus automatically clean the tubes.

The boiler auxiliary drives are getting to be pretty big pieces of machinery. Some of the modern boilers will take 700 or 800-hp, and there is a tendency on the part of the operators and maintenance men to neglect these auxiliary drives. Sometimes they are in a rather inaccessible location, and we find that the plant is shutdown because trouble is taking place with some fan drives because of lack of maintenance or people to look after them.

The suggestion that turbines be operated over a period of time, which might be a matter of four or five years, that is, the shutdown when the blast furnace needs relining, is rather startling. There are many turbines that have operated for that number of years without an inspection, but I am sure that the turbine manufacturers will not go along with that very enthusiastically. In central station practice, we now recommend that a turbine be given an inspection about one year after the initial operation and thereafter a complete inspection every two years. We have found that practice is quite satisfactory. Of course, Mr. Alexander's suggestion of taking stage pressure readings will give you some indication of the condition of the machine and will give you some warning as to trouble, if there is trouble, but it will not take care of possible progressive failures.

I notice in the maintenance program he takes care to examine the blades and magnafluxes them to make sure no cracks are present. There may be progressive failures present, or something might start which may not evidence itself for the first year or two years or three years, but it might give you some trouble after that length of time, so I am not sure that the manufacturers would go along with that long period of operation. As I say, I have known turbines that have gone longer than five or six years without an inspection, but in the larger units we, as manufacturers, would not recommend it.

The thorough manner in which Mr. Alexander's organization goes into this maintenance problem is certainly revealing, and if all steel mills went through that same process I am sure they would have less difficulty with turbo-generators and other equipment of that type.

John J. Alexander: I realize the suggestion that a turbo-blower might be operated for four or five years without dismantling for inspection is not consistent with our practice. I am certain that we would not be willing to operate a unit for that period without an inspection. However, it is unlikely that the blast furnace served by the unit will be able to operate without an interruption of sufficient length to permit an inspection for more than two years.

At times it is necessary to shut down a blast furnace producing 1000 to 1200 tons of iron per day in order to permit inspection of the turbo-blower by a specific date. If sufficient data was available to accurately indicate the internal condition of the turbo-blower, it would be possible to defer the turbo-blower inspection for several months until some other maintenance requirement of the blast furnace required an interruption. I am of the opinion that careful tests and accurate records of the performance tests will permit a more intelligent schedule to be used for turbo-blower inspection. This will provide a higher service availability factor for the machine and will permit greater tonnage to be produced by the blast furnace.

R. C. Hutchison: At the Bethlehem plant all steam, water, blast furnace wind and generated electric and pneumatic power come under the supervision of the combustion division and definite schedules for maintenance of these units are in effect. We attempt to meet these schedules as closely as is compatible with overall plant operating requirements. The experience here is that although some flexibility of schedule is necessary, in general they can be maintained within satisfactory limits from both a maintenance and plant operations standpoint.

TAPPING WITH THE JET CASTER

▲ At the meeting of the Eastern States Blast Furnace and Coke Oven Association which was held in Pittsburgh, Pa., on February 11, Bruce S. Old and A. R. Almeida of Arthur D. Little, Inc., described the latest developments which have been made on opening tapholes of furnaces with the jet caster.

The jet caster uses a small directional explosive charge (the idea is similar to the bazooka) which concentrates the blast and punches a hole through the crust of a tap hole. When used on blast furnaces, the jet caster is 2½ in. in diameter and 10 in. long and has 2 oz of explosive which is enough to blow a 2 in. hole through 8 in. of cast iron. There is sufficient insulation on the caster to allow it to stay in the iron notch long enough to let the operator make his connections and set off the charge. The explosive is stable and can be set off only by the blasting cap which makes it relatively safe to use.

The advantages of the jet caster are that it enables lengthening of the tapholes, the operator can better control the contour of the taphole, full flow of iron is almost immediately available, and greater uniformity is obtained in the size of the cast. In a series of 20 test casts at Republic Steel's Corrigan-McKinney works, on the No. 3 furnace, 18 were successful, one failed to open the hole, and one partially opened it. No damage to the hole was noted.

Republic Steel has also used the jet caster in their open hearth shop at Youngstown. A 1½ oz charge was used. No damage was noted in the hole, on the other hand its condition was improved. Greater care is required to prepare a taphole for an open hearth than for a blast furnace, but when this is done, it has been found that a melter can tap his furnace at once and thus prevents possibilities of losing the steel specification. Tapping time is reduced from 9-12 minutes to 6-9 minutes.

Further extensive experimentation is planned.

COAL PREPARATION FOR STEELMAKING

. . . . outlining a method by which impurities can be separated out of coal economically in large tonnage operations . . . .

By NELSON L. DAVIS
President
Nelson L. Davis Co.
Chicago, Ill.

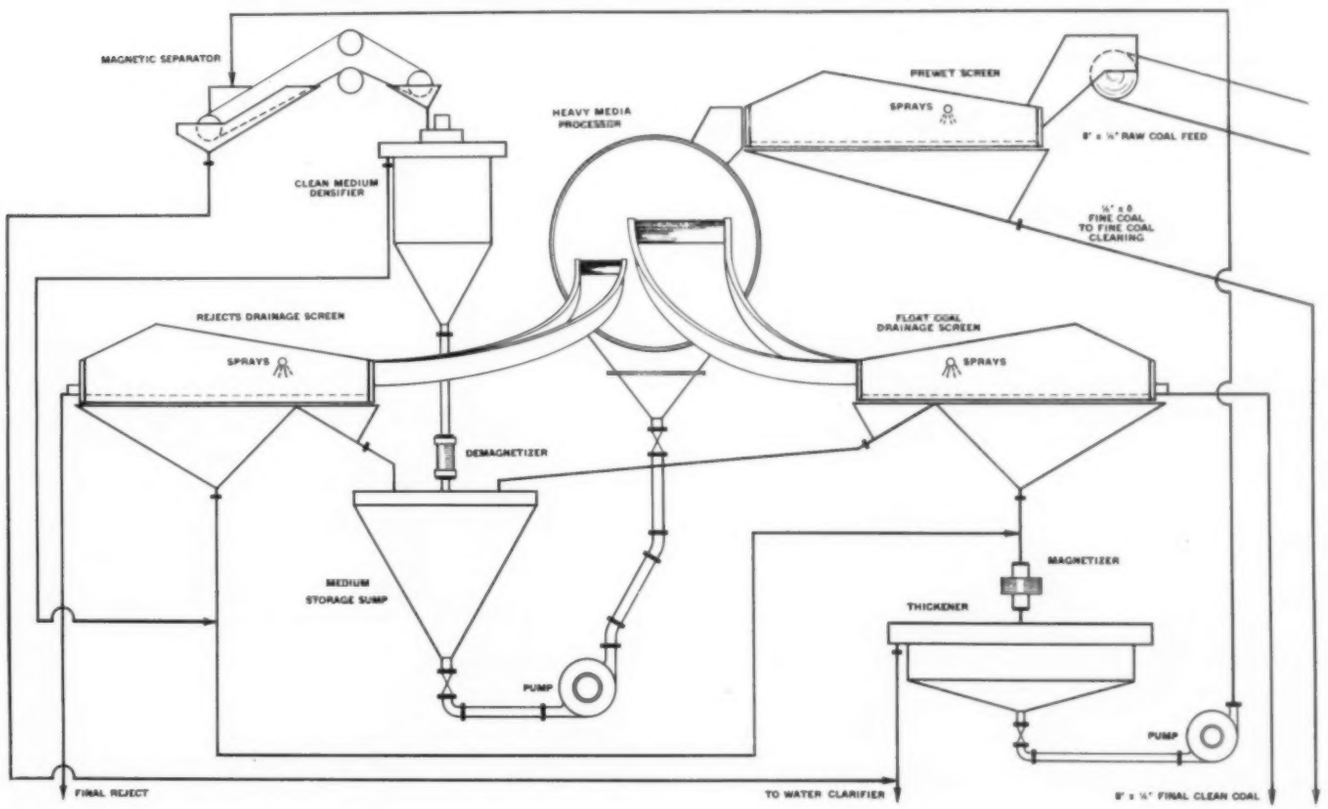
▲ THE advances which have been made in recent years in the mechanization of coal mining have made more difficult the problem of mechanically cleaning such coal. The miner was trained to recognize and discard those portions of a seam of coal which were high in ash and sulphur and difficult to remove at the washery. With total seam mining, the machine cannot do this since it can neither see nor think and must load the total seam product for delivery to the cleaning plant.

These changes in mining methods, combined with the fact that much of the better quality low sulphur coal has been removed from mines captive to the steel industry, have presented a serious problem in the mechanical cleaning of the coal. It will be necessary for the steel industry to look to other fields for coal of suitable quality for making blast furnace coke unless the problem is promptly solved. If the problem is solved, many captive mines contain as much as fifty years reserve coal tonnage which can be treated and recovered so that the quality is suitable for coking purposes.

This situation, while of vital importance to the steel industry, is equally important to producers of coal for industrial and domestic consumption where the mines have seams containing banded impurities locked up in

Presented before AISE Annual Convention, Cleveland, Ohio, October 1, 1948.

Figure 1 — Flow sheet of heavy media processing plant shows facilities for recovering and cleaning the medium, and also for dewatering the clean coal and reject products.



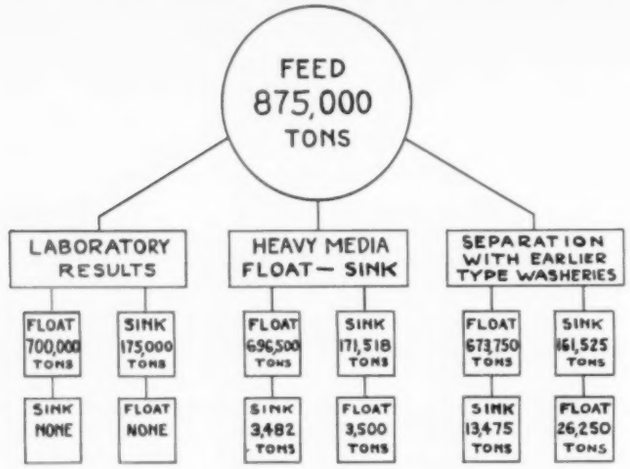


Figure 2 — The additional recovery by the heavy media process would save $147,875 a year for coal at $6.50 per ton.

material which is very close to the specific gravity of coal that is suitable for use.

Experience has shown that where jigs, launders and upward current classifier types of coal cleaning equipment will do an excellent job of removing rock and slate, as well as other free impurities which are not locked up in the structure of the coal, they are not as efficient in making separations of coal high in adherent impurities from coal low in such impurities. This is because the difference in specific gravity of the two kinds of coal is too slight to make such classifications possible with currents of water. In cases where such attempts have been made, they have invariably been at the expense of losing coal with the reject material.

In the laboratory, such separations are made without difficulty with heavy liquids such as carbon tetrachloride, zinc chloride, etc. Here a true float and sink separation is made which is based entirely on the difference of specific gravity, regardless of the size or shape of the particles. Through such laboratory procedure it is possible to determine the level of specific gravity which will yield a float coal that will match market requirements and also permit the recovery of the maximum of such float coal which exists in the seam which has been mined.

If such laboratory procedure could be expanded so that it could be carried on at capacities practiced at various cleaning plants, then that would be the answer. However, the cost of such heavy liquids and the losses of heavy liquid incidental to such a process make such procedure economically impractical.

In recent years much work has been done, both in Europe and in this country, toward the development of a float and sink process which is commercially economical and practical. The answer in all cases has pointed to the use of "heavy media" suspensions employing water and suspended solids which will not slime and cause an increase of viscosity for the medium. If a medium is used which does not slime in water, with the resulting increase in viscosity, it is not possible to make a true float and sink separation, because the sinking of small size particles is impeded, even though they are of high specific gravity.

This discussion will be kept free of arguments for or against any particular type of heavy media process so

Figure 3 — It is possible to produce coal low in ash and recover additional low ash float coal by crushing laminated middlings and recycling through the washer.

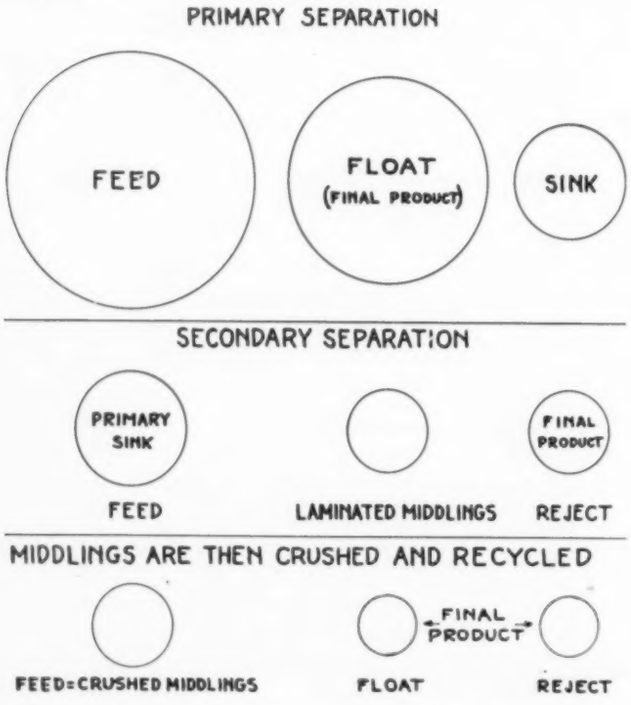
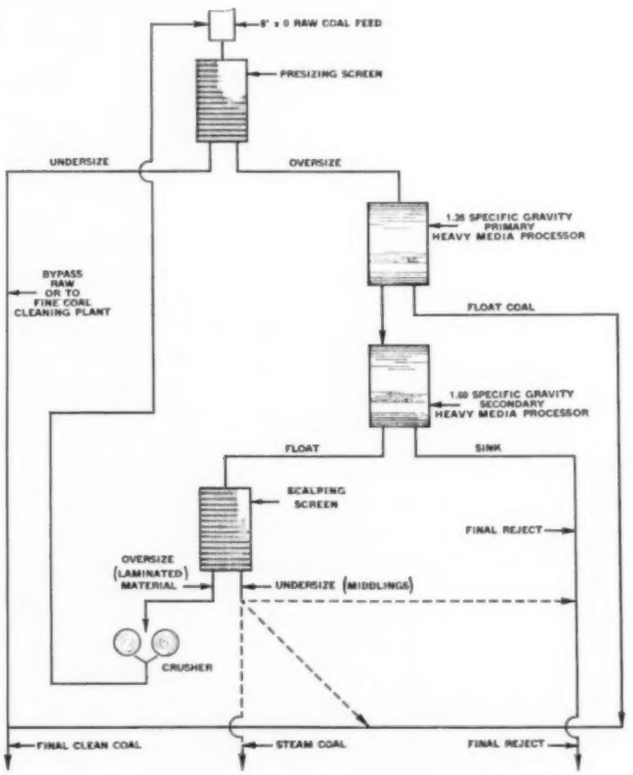


Figure 4 — Flow sheet illustrates two stages of heavy media separations and how middlings may be isolated, crushed and recycled for the recovery of metallurgical coal from laminated material.



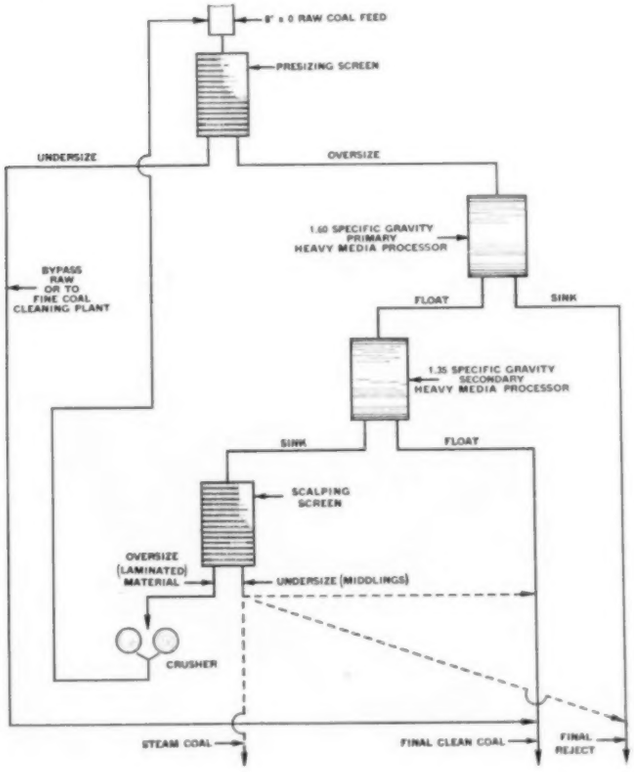
that the theory back of heavy media suspension will be made clear and permit the definite advantage accruing from its use to be made more realistic and apparent.

The theory of heavy media suspension is quite simple. Solid particles of like size, shape and specific gravity will settle in still water at uniformly constant velocity. This is referred to as the settling velocity of the media. Magnetite, for example, when ground to minus 325-mesh size has a settling velocity of 19 ft per hour. If magnetite is placed in water to which a rising velocity is imparted in excess of 19 ft per hour, it will be obvious that the magnetite particles could not possibly settle to the bottom of the vessel containing such water. Since each particle of magnetite would rise rather than descend, its effect is that of tending to lift particles which would sink in clear water. The more numerous the magnetite particles, the greater weight they can support in this manner. In other words, the more dense with magnetite particles the water becomes, the more resistance it has to the settling of solids of a greater specific gravity than water. The density of the medium is commonly referred to in terms of specific gravity because it is possible, by controlling the density, to gain a result which is almost exactly the same as that gained by the use of heavy liquids for float and sink separations.

It will be clearly understood from this explanation that the rising velocity imparted to the water is so slight that the effect of upward currents in destroying the float and sink result is negligible for all practical purposes.

If the process includes means for efficient recovery of the media, it is economical, and experience has shown that a cost of approximately one-third of a cent per ton

Figure 5 — This alternate flow sheet showing two stages of heavy media separations is used where rejects disintegrate rapidly into colloidal material when immersed in water.



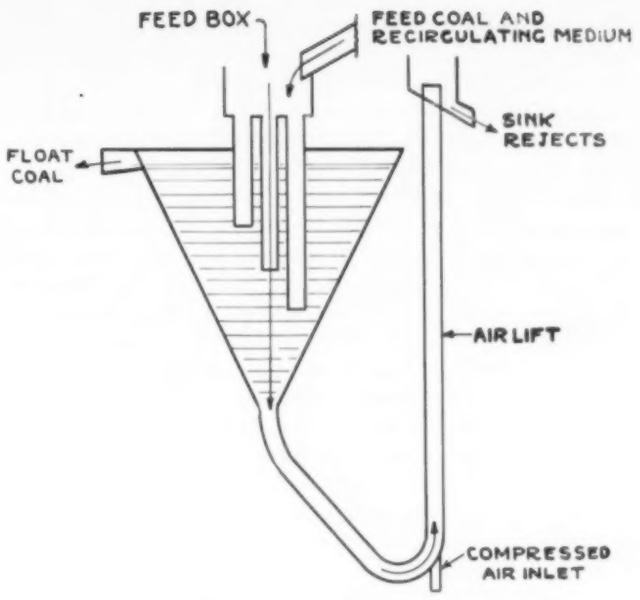


Figure 6 — Heavy media cone separator.

of coal treated can be reliably anticipated. See Figure 1.

Coal cleaning plants using the heavy media process have the outstanding advantages shown in Figure 2.

1. Reduction in the loss of coal with the rejects. Washeries having a feed capacity of 500 tons per hour commonly experience losses of 20 tons per hour. Using the heavy media process the comparable loss is less than 5 tons per hour, resulting in the recovery of 15 tons per hour. At the present mine cost for coal this represents a saving to the producer amounting to approximately $150,000 per year for a single shift operation.

2. The specific gravity of the medium (in other words, the level of specific gravity at which the separation of coal from its impurities is made) can be ad-

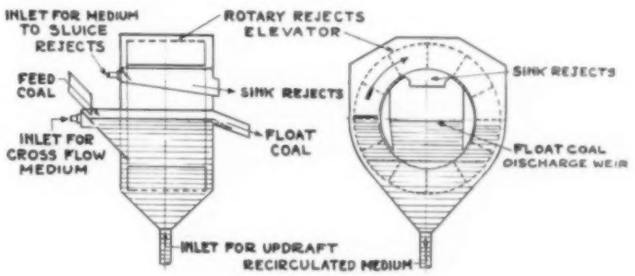
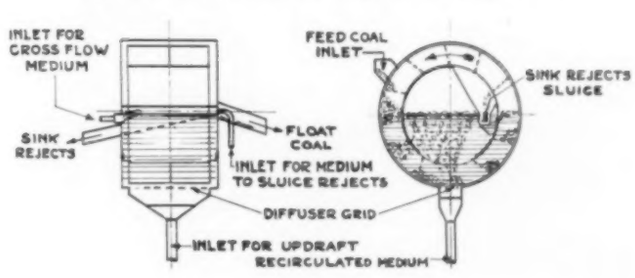


Figure 7 — Top feed heavy media separator.

Figure 8 — Underfeed heavy media processor.



justed between the limits of 1.30 and 1.65 in less than fifteen minutes. With float and sink separations, extremely high efficiency is maintained even at the lower levels of specific gravity which means that the operation at the washery can be carried on to produce coal having the ash and sulphur content best suited to market requirements. See Table I which gives ash content of typical western Pennsylvania coking coal in the float at several levels of specific gravity. At the same time, the maximum amount of such coal can be recovered out of the feed material which means a flexibility in operation never before enjoyed by coal producers.

3. With two stages of heavy media separations a middlings product can be derived along with a high quality float coal and a worthless reject. See Figures 3 and 4 and Tables II and III. If these middlings are comprised of good coal laminated with slate bands, notice 6 x ¼ in. sink at 1.39 specific gravity shown by Table III, they can be crushed to free the laminated impurities and recycled through the cleaning plant for a maximum recovery of high quality salable fuel. As it is possible to isolate a middlings product, crushing of the entire tonnage of feed material is avoided and is limited to include the crushing of only middlings. In this way it is possible to not only serve the highest grade markets but to release the maximum recovery of such coal out of the seam.

4. For recovering clean coal from seams which contain slate or rock impurities which disintegrate rapidly when immersed in water, the problem can be solved by making the first separation at high specific gravity which such rock is rejected within a few seconds after

TABLE I

Feed Coal Ash Content 23.96 Per Cent

Specific gravity	Per cent ash content	
	Float	Sink
1.60	10.46	72.42
1.55	9.75	53.43
1.50	8.98	41.62
1.45	8.41	37.84
1.40	6.14	36.28
1.35	4.87	34.73

TABLE II

Freeport Double Vein

(Full Seam Mined)

Gravity Fraction	Per cent weight	Per cent dry ash	Per cent dry sulphur
6 x ¼ In. Raw Coal			
1.53 Float	88.3	9.14	0.80
1.53 Sink 1.58 Float	1.8	32.71	0.65
1.58 Sink 1.63 Float	1.9	36.71	0.81
1.63 Sink	8.0	44.60	0.66
Total	100.0	12.92	0.79
6 x ¼ In. Float at 1.63 Specific Gravity			
1.53 Float	94.4	8.55	0.80
1.53 Sink 1.58 Float	2.9	32.57	1.15
1.58 Sink 1.63 Float	2.5	37.44	0.67
1.63 Sink	0.2	41.05	1.53
Total	100.0	10.03	0.81
6 x ¼ In. Sink at 1.63 Specific Gravity			
1.53 Float	0.8	9.13	4.27
1.53 Sink 1.58 Float	0.1	25.12	6.16
1.58 Sink 1.63 Float	0.7	38.40	1.61
1.63 Sink	98.4	50.38	1.57
Total	100.0	43.94	1.60

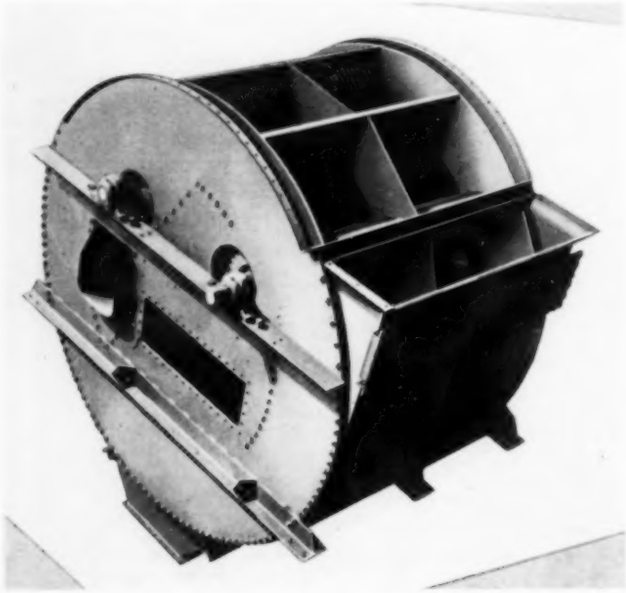
TABLE III

Freeport Double Vein

(Full Seam Mined)

Gravity Fraction	Per cent weight	Per cent dry ash	Per cent dry sulphur
6 x ¼ In. Float at 1.58 Specific Gravity			
1.29 Float	57.8	3.20	0.68
1.29 Sink 1.34 Float	16.1	7.05	0.87
1.34 Sink 1.39 Float	6.1	14.12	1.11
1.39 Sink	20.0	25.15	0.89
Total	100.0	8.88	0.78
6 x ¼ In. Float at 1.39 Specific Gravity			
1.29 Float	71.9	3.30	0.65
1.29 Sink 1.34 Float	20.3	6.90	0.83
1.34 Sink 1.39 Float	7.0	13.32	1.09
1.39 Sink	0.8	18.50	1.10
Total	100.0	4.85	0.72
6 x ¼ In. Sink at 1.39 Specific Gravity			
1.29 Float	1.0	3.22	0.62
1.29 Sink 1.34 Float	0.7	7.39	0.91
1.34 Sink 1.39 Float	1.7	15.37	0.94
1.39 Sink	96.6	24.80	0.83
Total	100.0	24.30	0.83

Figure 9 — Shop view of underfeed type of heavy media processor.



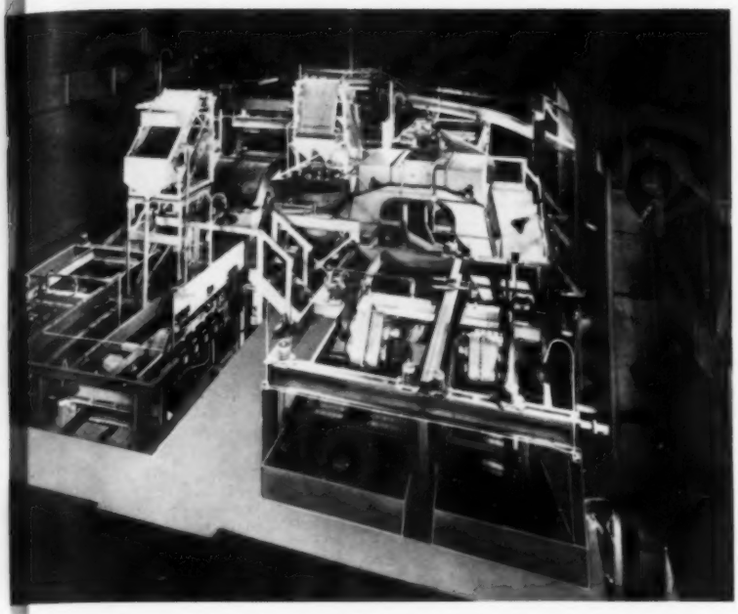


Figure 10 — General view of heavy media coal cleaning plant shows arrangement of processors, magnetic separators and drainage screens.

it is submerged in water as shown in Figure 5. The float product from the primary separation is then retreated at a lower level of specific gravity for the recovery of high quality float coal and the isolation of the middlings product which can then be crushed and recycled through the plant.

5. The practical approach to the solution of the problem of gaining maximum recovery of suitable coal from the run-of-mine commences in the laboratory and is as follows. First, separate the plus ¼ in. into the following sizes and determine the percentage of each size:

+8 in.
8 in. x 5 in.
5 in. x 3 in.
3 in. x 1 in.
1 in. x ½ in.
1 in. x ¼ in.

Then segregate each size into the following float and sink fractions and determine the per cent of the total represented by each fraction.

1.35 float
1.35 x 1.40
1.40 x 1.45
1.45 x 1.50
1.50 x 1.55
1.55 x 1.60
1.60 sink

Each fraction is then analyzed for ash and sulphur content. Visual inspection of the middle gravity portions of the sample will reveal whether the impurities are laminated or finely dispersed. If laminated, it will pay to crush the material to release good coal.

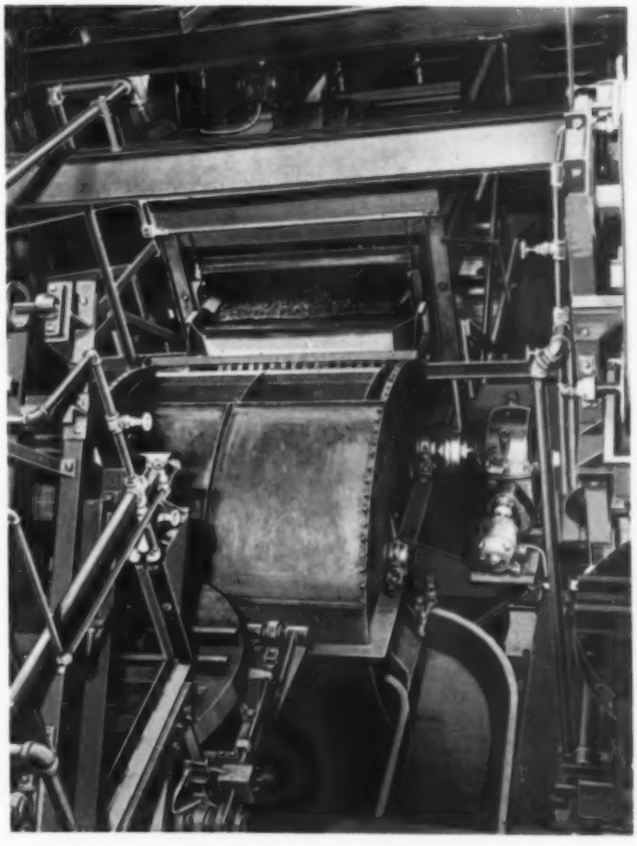
Here one great advantage of heavy media float and sink separation becomes immediately apparent; its ability to separate at low gravities. Thus, after the raw coal has been treated for the removal of reject material, the float portion is retreated at a lower gravity which has been established in the laboratory as best suited to yield a suitable float coal product. The sink portion contains the objectionable laminated impurities which can be released by crushing and from which coal of good quality can be recovered by retreatment. Thus the greatest amount of salable fuel is realized by crushing only a small portion of the feed coal instead of all of it.

Stated in another way, it is now possible to separate at the gravity which will yield low ash premium sizes without wasting coal to rejects, because such sink coal has been isolated from both the final float coal and rejects products and may be separately crushed and retreated for the maximum recovery of salable fuel. For every ton per hour thus recovered the producer earns nearly $20,000 per year on a two shift per day operation and at the present day price of coal fob mine.

There is another operating and economic advantage for heavy media separations. Float and sink differs from upward bearing classification in that size and shape have very little bearing on the result of the separation. The difference in specific gravity is the only

Figure 11 — In the processor, the coal is submerged in liquid medium of the correct density. As the rotor of the processor revolves, the coal is carried downward through the "bath." The "float coal" rises through the bath and is discharged over a weir on one side of the processor where it is then sluiced to the float coal drainage screen. The sink material is carried forward and upward out of the bath by the rotor and is delivered to a flume on the opposite side of the processor leading to a rejects drainage screen. The medium which drains freely through the screens is returned to the sump. Both screens have water sprays which rinse the coal of any adhering medium.

The density of the medium is automatically held constant at the correct level to produce a desired result but can be varied at the will of the operator between the limits of 1.30 and 1.65 specific gravity in a few minutes.



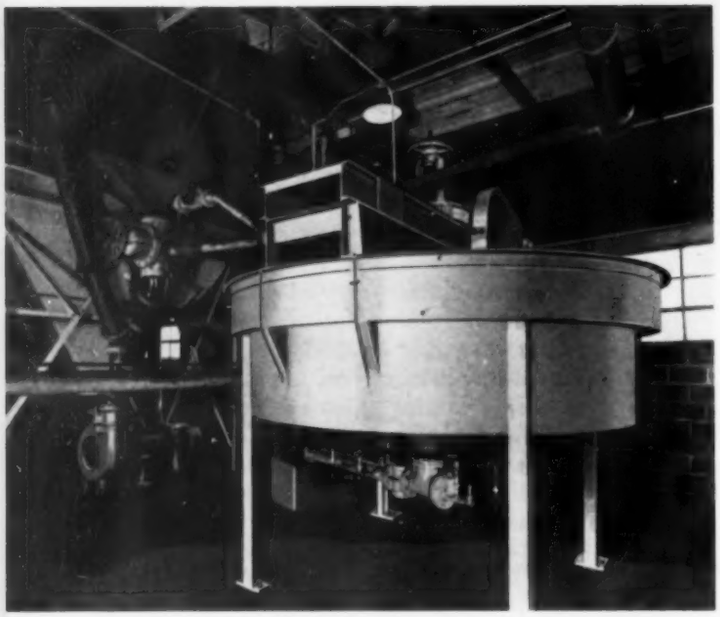


Figure 12 — In the medium thickener, magnetically flocculated medium settles and most of the process water and non-magnetic solids flow to separate water clarification facilities, while the settled material is removed through the bottom discharge opening and pumped to the magnetic separator which completes the recovery of the magnetite. At left is the medium storage sump.

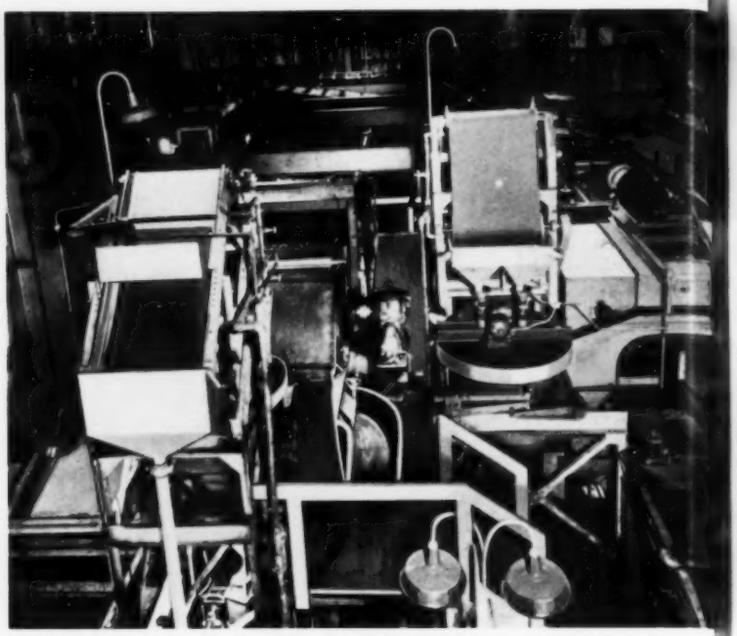


Figure 13 — Magnetic separators recover magnetic concentrates and discharge them to the medium pump sump after they are densified in unit below the magnetic separator.

factor seriously involved. Thus picking tables may be dispensed with for sizes under 10 in., and where two stage cleaning is used, because the primary separation can be on the so-called "black and white" basis. Laminated material is rejected separately in the secondary stage of separation to be crushed and retreated for recovery of the coal binders previously described.

Savings in the initial plant cost, power and space are other important advantages.

Figures 6, 7, and 8 show three types of heavy media separators now in use in coal cleaning plants. They are of the cone, top feed and bottom feed constructions, respectively. Figure 9 shows a view of an underfeed type of heavy media processor shown in Figure 8.

Several views of a pilot plant in which primary and secondary heavy media separators are installed are shown in Figures 14 to 23.

The development of the heavy media process inaugurates a new era of coal cleaning efficiency for coal producers. In some instances, it has made, or will make it possible, to use the output from mines which otherwise would be unsuited to market requirements. In other cases, mines containing coal seams in which there is a considerable amount of low gravity, high ash material, can now be operated profitably and still produce coal for the higher priced markets. In all such cases, both the producer and the user benefit. Likewise, our country benefits through the diminishment of wastefulness and our national resources for coal are conserved.

In conclusion, the heavy media process supplies the much needed mechanical facilities to adequately and efficiently clean coal which has been mechanically mined.

Make your plans to attend!

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MAY 2 and 3, 1949

THE ART OF ROLLING FLATS

. . . . explaining rolling procedure for the production of flats with particular attention to the effect of roll design . . . .

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▲ THIS paper is an attempt to outline the various methods of producing flats, including details as to practice, methods or procedures and equipment used. There are no intentional references made regarding the most desirable method or practice, since individual mill layouts and final end use of the material rolled is an important factor in deciding roll pass design.

The outlined methods consist of square-edge flats produced with the step-and-edging and tongue-and-groove methods. Reference is also made to near-square flats produced by the use of fluted square and edging grooves, and the use of diamond groove with long and short sides finishing on the angle, usually termed the diagonal method. The processing of different grades is also considered from the rolling point of view.

FLAT CLASSIFICATION

It is difficult to definitely classify when a rolled flat is a bar and not strip. There are times when flat sections are rolled as bars, and shipped as strip. However, widths 3½ in. and under, with the thickness 0.203 in. and over, are considered bars. Exceptions to this are spring steel, which can be of the same width, 3½ in. and under by 3/16 in. and over in thickness, and still be classified as bars. The section 3½ to 6 in. wide x 0.203 in. and over in thickness is classified as a bar unless it is cold rolled, then it is strip. Also, a mill may be rolling 4 x ⅛ in. in straight, hot bed lengths, shear to mill length, then the mill will usually classify these as bars or thin flats. They may also put the same section into coils and classify them as hot rolled strip to be cold rolled.

There is also the classifying of near-square flats or nut sections. Again, the classification by mills may vary, as some classify as near-square sections when the width is equal to, or less than, double the thickness. Others may classify them as near-squares when thickness equals 75 per cent or more of width.

HAMMERED OR FORGED FLATS

There are today a number of flat sections which are forged, especially of the tool steel grades. Most tool and alloy steel plants are equipped with hammers of various capacities which facilitate the producing of small orders and the processing of highly alloyed grades.

Flats can be produced on the hammer with very sharp corners and with a reasonably uniform size and surface. However, this requires considerable forging skill to produce a bar with a uniform thickness and edges having a 90 degree angle. To the expert hammerman this is mainly accomplished by judgment. There are many expert hammermen producing flats that are difficult to distinguish from rolled bars. There are some grades of stainless that are very difficult to hammer, because the nature of steel is susceptible to folds caused by the action of the hammer die on the steel. This is especially noticeable on small sizes.

It is very desirable to have billets proportional to the finished size. This not only assists in producing a better product, but increases the production from the hammer, as it eliminates the extra heating, excessive decarburization and excessive scale.

When large sizes of flats are required, especially highly alloyed grades, they are usually hammered, because usually only one or two bars are required, also the steel may be too hard to roll without damage to the mill.

METHODS OF ROLLING FLATS

Flats or flat wire was, possibly, one of the first sec-

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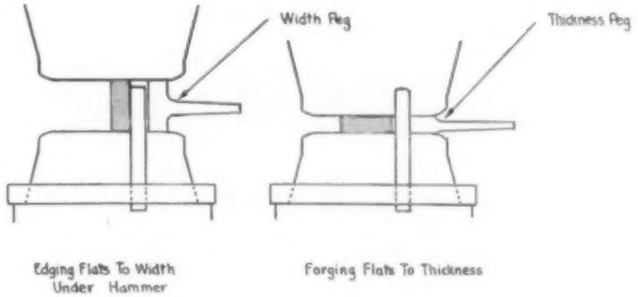
Figure 1 — When forging, considerable skill is required to produce a flat accurate to size with square edges.



Presented before AISE Annual Spring Conference, Buffalo, New York, April 26, 1948

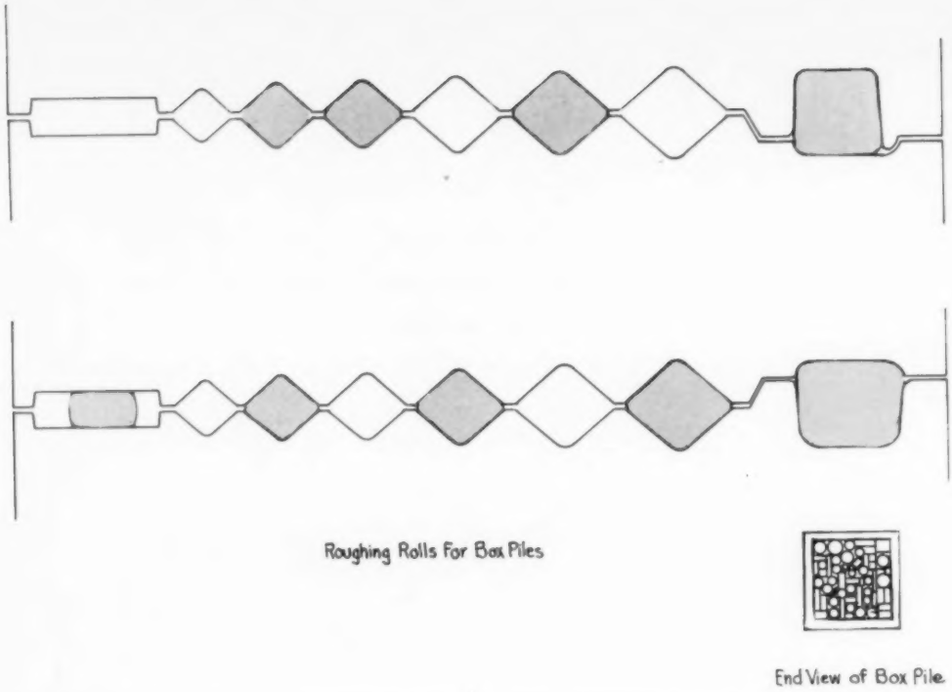


Figure 2 — The first and second pass support the box pile on three sides to aid in welding.

tions to be rolled. Flat sections were produced previous to other sections mainly due to the fact that only plain rolls were needed. However, before the processing of steel, iron was rolled from box-piles which were assembled, for example, by placing a 4 in. wide flat on the bottom with the flats on each side and filling the box with scrap iron, usually consisting of nuts and bolts, then tied together with wire and placed in the furnace and heated to a welding temperature. This brought about the necessity of having rolls that contained or covered the section; therefore, flats produced from iron were rolled by the tongue and groove method. This design produced a pressure on sides and edges, and had a tendency to heal or assist in maintaining the weld on the section. The actual weld had usually taken place in the earlier passes. It was necessary that the rougher handling boxpiler's used good judgment as well as being a good tongsman. It was very essential to have the cold side of the box-pile turned on the bottom side, otherwise the bar would deliver in a semi-circle which possibly could not be entered back into the mill.

Tongue-and-groove flat rolls are still used in some plants today, on a limited number of sizes, usually wide sizes that are not in proportion to roll diameter. This also facilitates handling by elimination of edging. The roll setup is quite expensive when a wide range of flats has to be produced. One of the difficulties is that the grooves wear wide due to work on the edges of the bar which causes the finished bar to become wider than the desired finished size. This can be overcome by edging and then finishing on plain rolls and also by turning new rolls to the low side of tolerance on width, which prolongs the life of the roll.

Another reason for using an edging groove is to eliminate the unparallel edges caused by the necessity of having one degree or more of opening which is necessary to deliver the bar and facilitate redressing of tongue and groove passes.

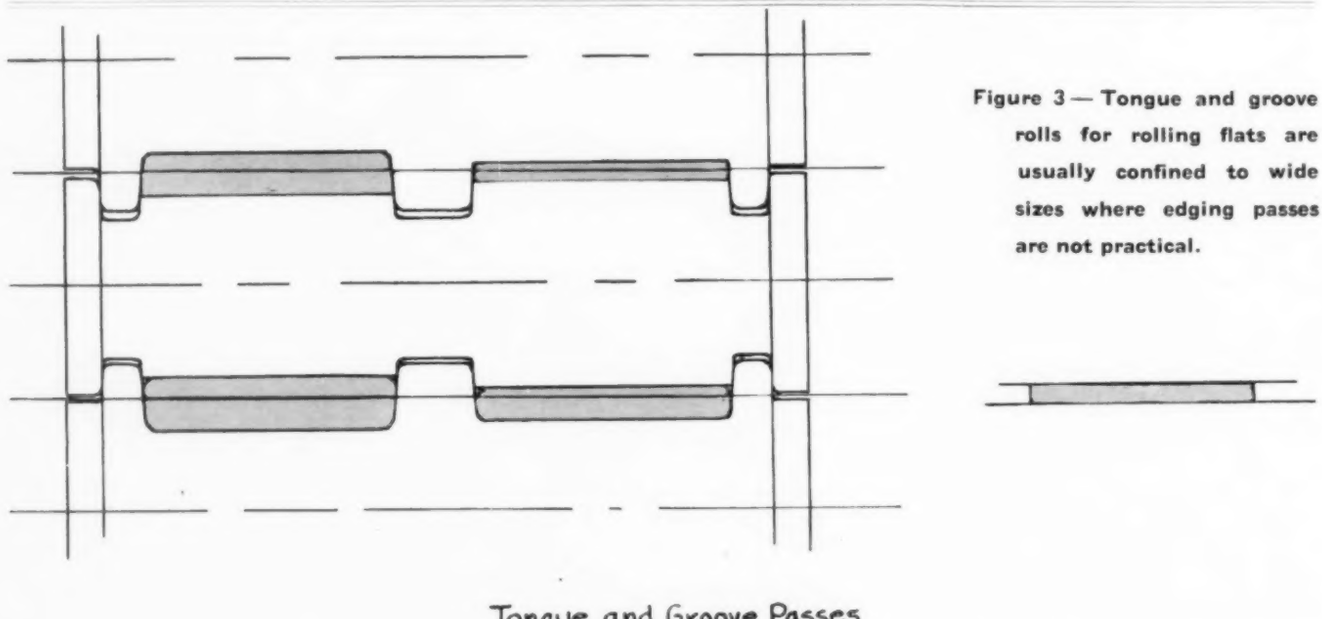


Figure 3 — Tongue and groove rolls for rolling flats are usually confined to wide sizes where edging passes are not practical.

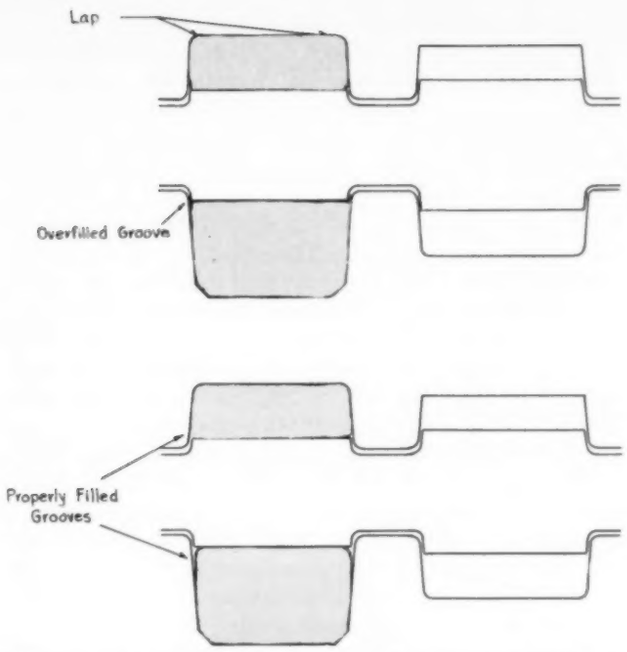
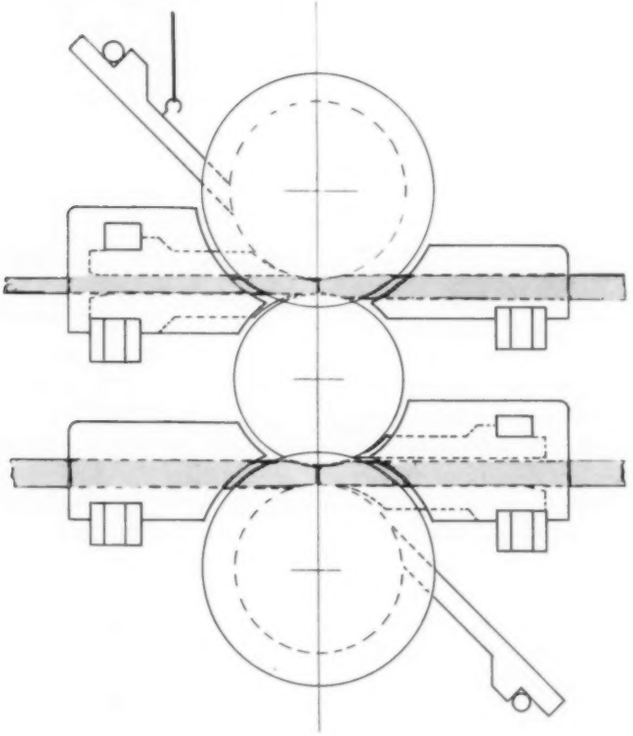


Figure 4 — It is important to have the proper amount of stock entering the first tongue and groove pass to avoid collaring or overfills.

To overcome the possibility of collaring, it is necessary to keep the amount of stock entering the first tongue-and-groove pass to a minimum, keeping in mind the width required to produce corners on the finished bar. Once the stock increases to the extent of crowding the tongue-and-groove pass, a large amount of pressure is exerted on the guide in the grooved roll. It is, therefore, necessary for the roller to maintain the proper amount of stock in the first tongue-and-groove pass,

Figure 5 — Extra precautions such as safety guides assist in eliminating collaring.



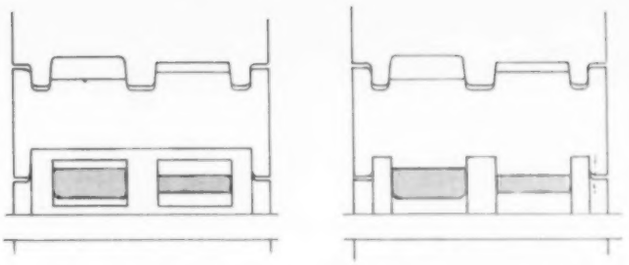


Figure 6 — On the left is shown a solid entry guide box and on the right are shown entry side guards.

and all other passes, to eliminate guide breakage and collaring.

The first step is to determine the amount of stock to enter into the first tongue-and-groove pass that will produce a finished bar with sharp corners. The stock entering the first tongue-and-groove pass may be provided by a billet mill in slab form or, if the mill is equipped with a roughing stand and adequate intermediate and finishing stands, a square bloom can be used.

On a three-high set of tongue-and-groove flat rolls, delivery from between the middle and bottom roll can be done with the delivery guide in the collared groove,

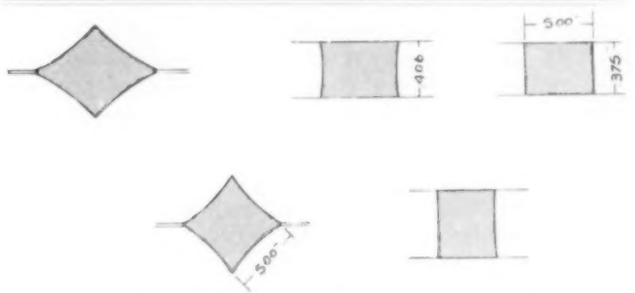
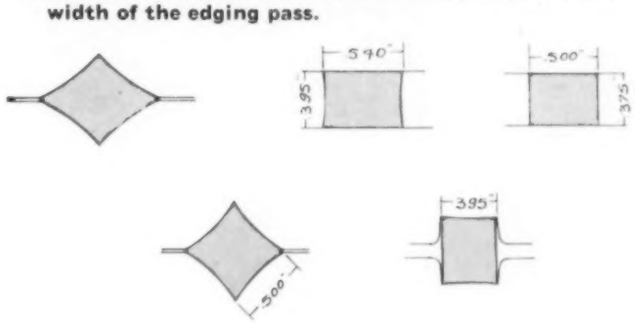


Figure 7 — Proper size and the amount of concave of the square is very important when edging near squares on plain rolls.

as there is practically no danger of the bar following the tongue roll. The same applies to delivery from between the top and middle rolls. However, the safe method is to set up with a guide stripping the bar from each roll. Also a safety guide is generally used in the grooved roll and is placed underneath the regular guide in the bottom roll. This extra precaution will assist in eliminating collars in the grooved pass. The same set-up can be provided on the top roll.

When only one pass is being used in each set of rolls, a guide box is generally used. When more than one pass

Figure 8 — Thickness of entering flat must coincide with width of the edging pass.



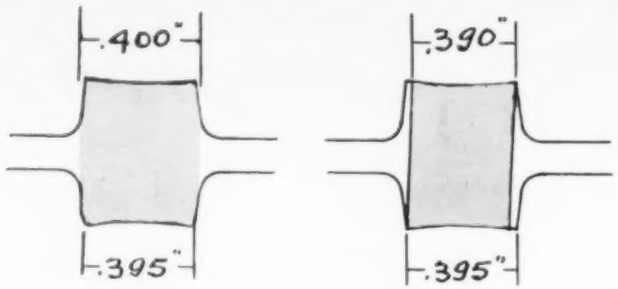


Figure 9 — The thickness of the flat on the left is oversize, and that on the right is undersize.

is being used in one set, sideguards are sometimes used, also a solid box covering the total length of the roll, with divisions between passes the same width as the collars.

ROLLING OF NEAR-SQUARE FLATS

A method of producing near-square sections is through the use of fluted squares, either by flatting on plain rolls and edging on a plain roll, or by edging in an edging groove.

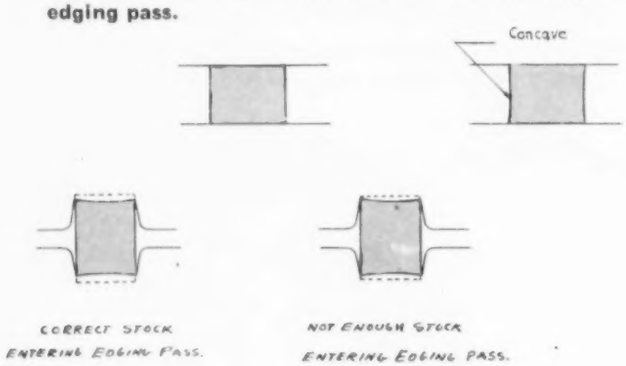
For example, with 0.500 x 0.375 in. section, the first step for the roller to determine is the proper size fluted square, always taking into consideration the grade of steel to be produced. Too small a square will cause poor surface and a poor delivery, usually resulting in twisted bars. Too large a square will cause convexed edges. First, the fluted square rolls must be close together to produce a square with equal flutes or radius on all four sides, plus equal opposing diagonals.

When a fluted square is designed and turned, for example, to produce a 0.500 in. square, it is difficult to produce anything larger or smaller from the groove and maintain a square section. After a uniform 0.500 in. square is obtained, it is then entered into a flat pass and reduced to 0.406 in. in thickness. At this point, the edges of the rectangle should be at exactly 90 degrees from the width or the wide part of the section. The edges should be flat and not convex, and it is preferable to have the edges slightly concaved. The section is then entered on edge into plain rolls, then into the finishing pass to obtain the thickness. It is difficult to produce a section by this method entirely free of convex on the edges, however, it can be held to a very minimum amount. The appearance of the section is excellent as the corners are sharp and the surface is clean and smooth.

The same section, 0.500 x 0.375 in., can be produced with a fluted square, flat in plain rolls, then edged in a 0.406 in. edging groove designed and turned with the proper convex in the roll to produce a section from the finishing pass without convex or concaved edges. Where long bars are being rolled, it is desirable to have the minimum amount of draft in the finishing pass necessary to deliver the section. Therefore, the edging groove could be 0.395 in. and the section entering the edging groove should be (when producing 0.500 x 0.375 in.) 0.540 x 0.395 in. This will produce a section in almost any desired hot-bed length, with a minimum of variation from the front end to the back end. The roller should know, to the thousandths, the width of the edging groove he is using and maintain the thickness of the section the same as the width of edging to produce a square and uniform section. A section 0.005 in. greater in width than the edging groove will cause poor corners and also wear the edging groove wide. A section 0.005 in. less than the width of the edging groove will cause the section to run slightly off square.

With the section entering the edging groove, the exact width of the groove and the section delivering from the finishing pass with a slight concave, the roller can then increase the height of the section entering the edging groove. If the section is delivering from the finishing pass with convex edges, the height of the section entering the edging pass must be decreased. This is assuming that the convex in the edging groove is in proportion to the draft on the section from edging groove to the finished thickness. Edging grooves are designed and turned with a varying amount of draft in the finishing pass, which may be from four to twelve per cent. This is governed by the grade and the tolerance specified.

Figure 10 — Edges of the finished flat can be controlled, to some extent, by the width of the flat entering the edging pass.



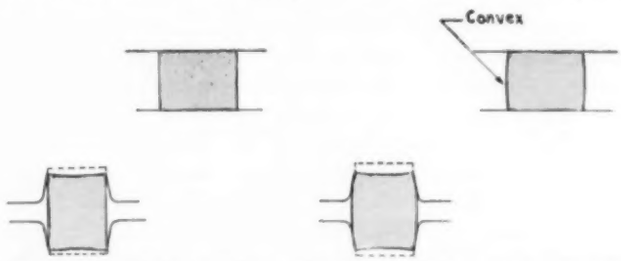


Figure 11 — The correct amount of stock is entering the pass on the left but too much stock is entering the edging pass on the right.

Delivery of a near-square section, without a twist, is sometimes difficult.

The roller will first check the section coming from the edging, also the thickness of the finished section on both edges. If the dimensions are uneven they cause a twist. If this condition does not exist, the next thing is to check the finishing rolls for eccentricity. Some rollers prefer to use a loose chock on the outside end of the top finishing roll, using a wedge on each side to push the roll, either toward the delivery side, or entry side. If the section is twisting towards the inside (inside usually determined by the drive end), the outside end of the finishing roll is wedged or thrust toward the entry side. Should the bar twist out, it is then necessary to wedge or thrust the roll towards the delivery

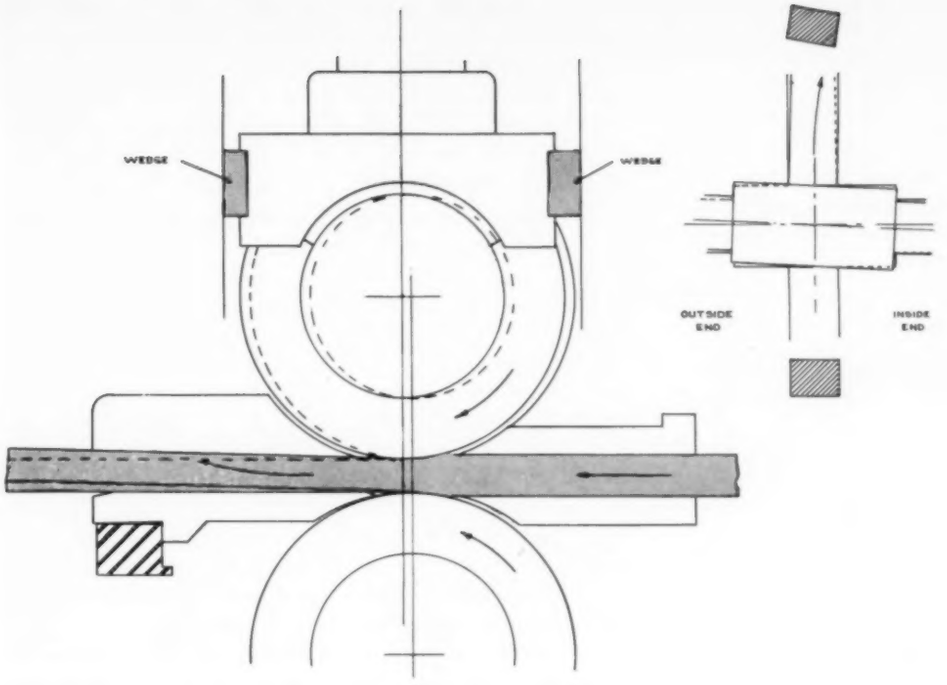


Figure 12 — Exact alinement of the top and bottom roll is essential to deliver a flat without twist or camber.

side. Screws through the housing are sometimes used in place of the wedges.

DIAGONAL METHOD

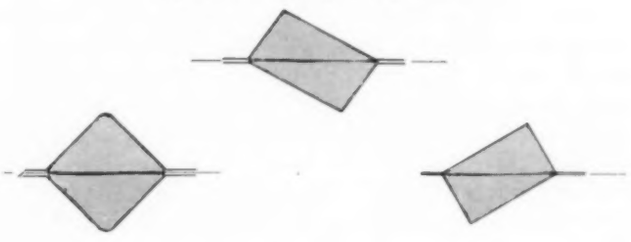
Nut flats or near-square sections are also made on the diagonal, using a diamond pass in the leaders designed and turned with a long and short side in each roll. The long side is made to conform to the long side in the finishing pass and the short side to conform to the short side of the finishing pass.

This design assists in maintaining a uniform section, as all sides are in contact with the roll. The main points the roller has to watch and make adjustments for are overfill and underfill on the open corners, twist, and that the edges and width are maintained to the tolerance specified. Should the open corners be overfilled, it is necessary to close the leader, or diamond pass. If the corners are empty, the diamond can be opened but always making certain that rolls are straight or alined properly.

This method is not very satisfactory for highly alloyed steels, due to pressure on the entry and delivery guides. However, on sections with large tonnages involved, for example, $\frac{3}{4}$ x $1\frac{1}{16}$ in., some mills prefer this method, as a section in this proportion can be rolled with certain advantages over the flat and edge method.

The delivery of this type of section, when rolled on the diagonal, is usually difficult to deliver without a twist. Mills rolling nut iron use an adjustable delivery guide to deliver the bar straight. Some of these assemblies were equipped with rollers to prevent wear and scratching.

Figure 13 — Diagonal grooves.



ROLLING OF FLATS — STEP-AND-EDGE METHOD

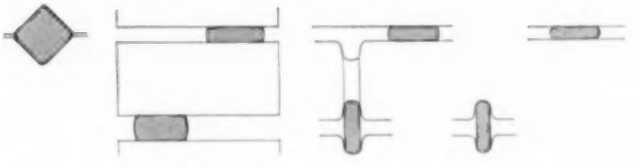
The method of flat-and-edge rolling is generally used in mills where alloy grades are produced. The advantages of this method are flexibility, good surface and section, combined with economical roll cost for the number of sections that can be produced.

The use of three-edging is generally used. Some mills use four-edging and some only use two, however, it is difficult to maintain a uniform section and sharp corners with only two-edging.

Production or continuous mills, with only one pass in each stand, flat in one stand and edge in the next. Mills with less stands, such as the average tool steel mill, usually have one stand set up with step rolls to reduce the square to the thickness desired to enter the first edging groove.

The amount of stock required to produce a sharp-cornered flat from a round-cornered square remains nearly constant, regardless of the number of edging passes. Using two or more edging grooves, the roller can proportion the amount of edging draft in accordance with the number of edging passes.

Figure 14 — Two edging passes are usually considered sufficient to make a round-edge-flat.



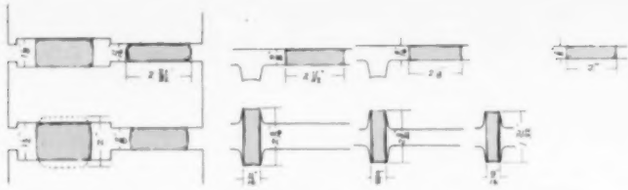


Figure 15 — The distribution of the flat and edging passes depends largely on the mill layout. Three edging grooves are shown in this figure.

ROLLING PROCEDURE FOR A SPECIFIED FLAT

Almost every roller has a method of determining the size of square necessary to produce a sharp-cornered

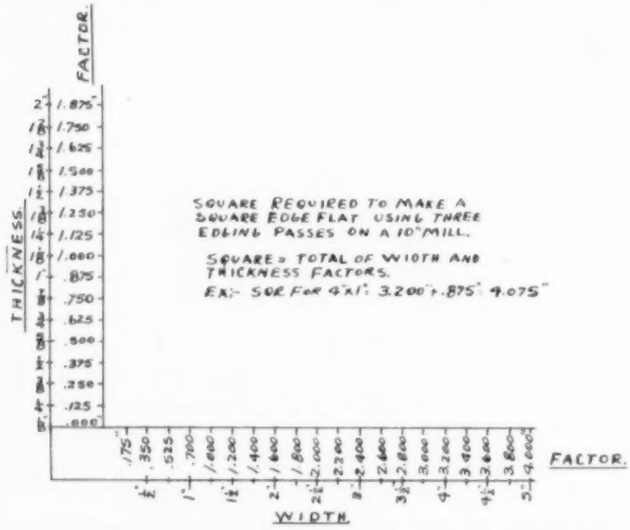
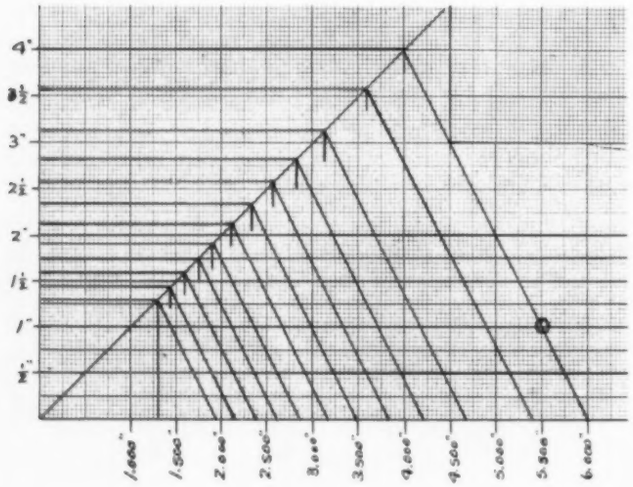

FACTOR
THICKNESS
SQUARE REQUIRED TO MAKE A SQUARE EDGE FLAT USING THREE EDGING PASSES ON A 10" MILL.
SQUARE = TOTAL OF WIDTH AND THICKNESS FACTORS.
EX:- SQE FOR 4"x1": 3.200"+.875" 4.075"
FACTOR
WIDTH

Figure 16 — Charts of this type are usually calculated, then drawn from actual experience on one or more known sizes.

flat, with a minimum of variation of size on thickness and width.

One simple method that is easy to remember and can be applied is the following—for example, 2 x 0.500 in.

Figure 17 — Graphs of this type are usually drawn from actual data on one or more experiments and will vary with size and the speed of the mill. Diagonal lines indicate spread = 50 per cent of draft. Example: 4 x 4 in. rolled to 1 in. thick = 5½ in. wide.



square edge flat with three-edging passes—add the width and thickness, or 2.5 in., then take 80 per cent of the total, or 2.000 in. round cornered square, for a 2 x 0.500 in. square edge flat. For 2 x 0.500 in. round edge with two edging passes, add the width and thickness, then take 70 per cent of the total, or 1.700 in., which equals the size of square that is necessary.

The use of this method is advantageous when a roller is starting a new mill. Once he has gone through the cycles, he will have obtained the dimensions of the section of each pass, which is important when attempting to produce a uniform finished section.

The general practice in most mills for the leader edging grooves for square edge flats is as follows: ⅛ to ½ in. thick, the edging grooves are designed and turned to be used 1/32 in. over the finished thickness; ½ to 1 in. thick, the edging grooves are designed and turned to be used 1/16 in. over the finished thickness; 1 to 1½ in. thick, the edging grooves are designed and turned to be used ⅛ in. over the finished thickness; 1½ in. and up in thickness, the edging grooves are designed and turned to be used ¼ in. over the thickness of the finished bar.

In regards to the second edging, which is similar to the first edging, the same amount of reduction is used in proportion to the thickness of the preceding flat. Rolls are designed and turned, with the proper amount of convex in each edging groove, to coincide with the amount of reduction from the edging groove to the next flat thickness.

In planning, for example, to produce 2 x 0.500 in. square edge flat, using three-edging grooves, first, the roller will choose the edging grooves, third edging or leader (last edge before the finishing pass, 9/16 in. second edging, ⅝ in.; first edging, 1 1/16 in). He will determine the size square to be used, using the method mentioned previously. This would be a 2 in. round-cornered square, with equal opposing diagonals. This square is then reduced in four, flat passes—first is 1½ in. thick, the second is 1⅛ in. thick, the third is ⅞ in. thick and the fourth is 1 1/16 in. thick. The average spread is approximately 50 per cent of reduction when performed on plain and smooth rolls, therefore, the section entering the first edging will be 2 21/32 x 1 1/16 in. Reducing the width in this first edge to 2 5/16 in., then flat to ⅝ in., this section entering the second edge is now 2 11/32 x ⅝ in. The width is reduced to 2 3/32 in., then flat to 9/16 in. The section entering the third and last edging is 2⅛ x 9/16 in. The width is reduced to 1 15/32 in., then entered into the last flat or finishing pass. At this point the roller must obtain a rectangle with four, sharp corners, with the thin edges of the rectangle at 90 degrees from the wide dimension of the rectangle and with no convex or concave on the edges.

CONVEXED EDGES

After the roller has checked the section for size and squareness, he finds an objectionable amount of convex on the edges. We will consider the edging grooves to have been tried and proven. A roller, experienced in producing flats, will first check the thickness of the flat entering the third or last edging (this should be done with a micrometer). If this dimension is 0.562 in., he will reduce the width of the section entering this edging

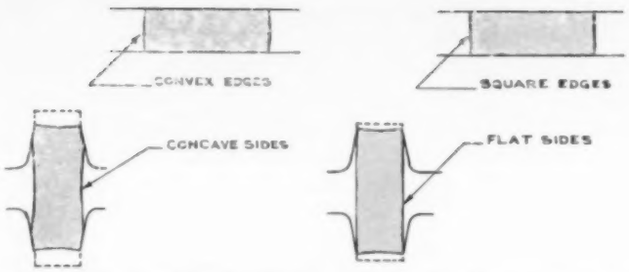


Figure 18 — On the left, too much stock is entering the edging pass, but on the right the correct stock is entering the edging pass.

pass possibly $\frac{1}{16}$ in. This also makes it necessary to reduce the draft from the first to the second edging. After making the corrections, the roller then checks and finds that he has eliminated the convex.

The reason the convex has been eliminated is through

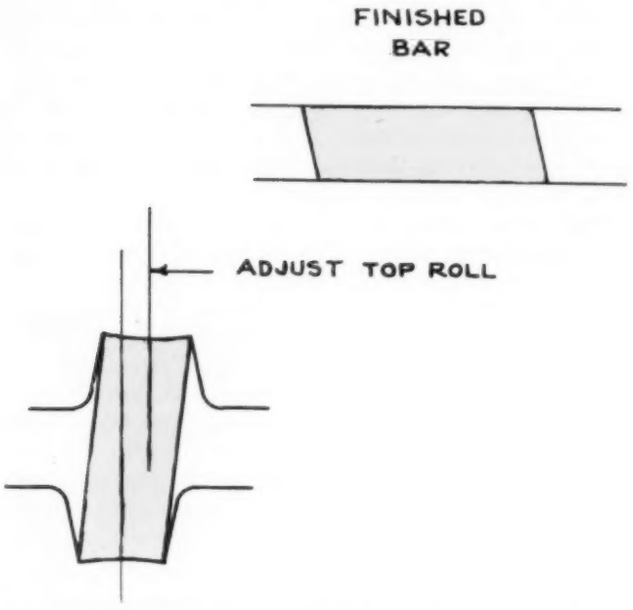
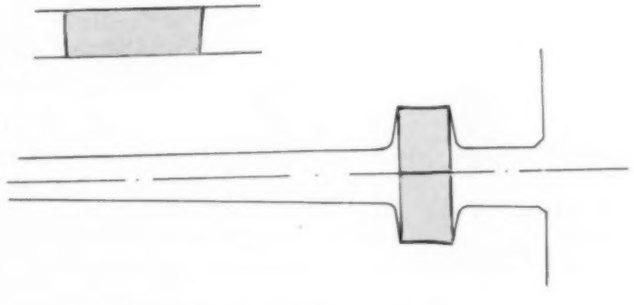


Figure 19 — When the leader edging rolls are crossed, the finished bar will be as shown at the top.

the reduction of draft on the width of the section going through the edging. This has reduced the amount of metal being forced from the width into the thickness of the section. If the finished section is concaved, a reverse procedure is used. More width is added, thus increasing the stock.

Figure 20 — Rolls are not level due to uneven bearing pressure.



SECTION OFF-SQUARE

Should the section be found to be off-square, with the top corner on the inside and the bottom corner on the outside longer than the other diagonal, it is necessary to thrust the top edging roll towards the inside. Should the opposite diagonals be long, the procedure would be reversed. However, when the section is off-square, all edging passes should be checked.

Should the section be found to be off-square on one edge and square on the other, for instance, the edge delivering from the bottom of the edging groove can be caused by the edging rolls not being parallel during the time that the bar is in contact with the rolls. For example, should the edging roll be 24 in. long and the groove used being on either end but the extreme end, a condition of this kind makes it necessary to increase the clearance between the rolls on the opposite end, to compensate for extra spring in the bearings on the end of the roll where the bar is passing through.

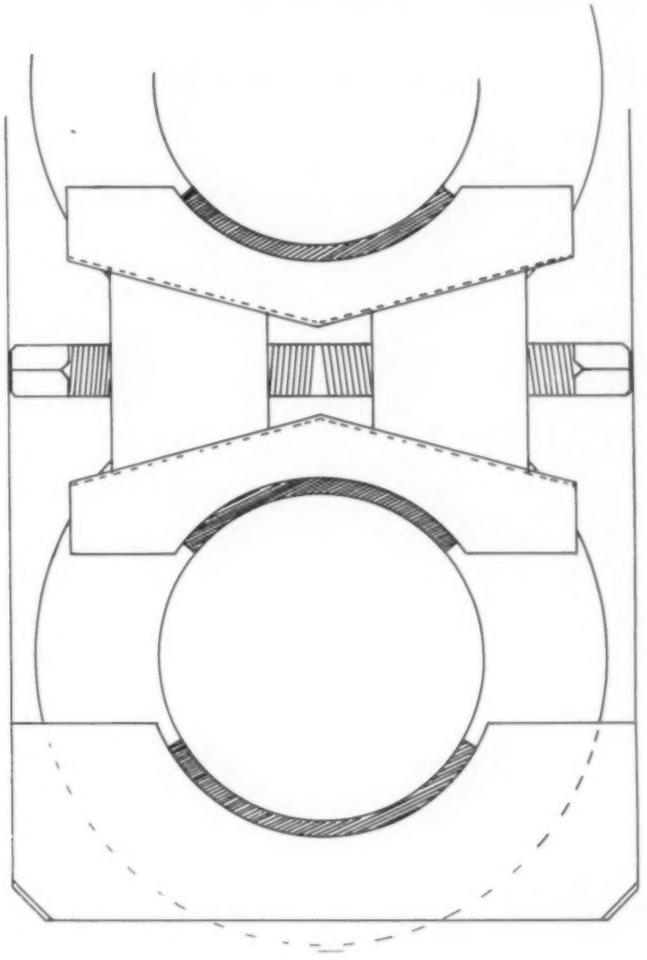


Figure 21 — The wedge type hold-down assembly aids in eliminating spring.

Another method to overcome this condition is to use an adjustable wedge-type arragement between the two rolls, tightened to the extent of exerting enough pressure to force the rolls apart, which in turn assist in eliminating the spring. This arrangement can be used

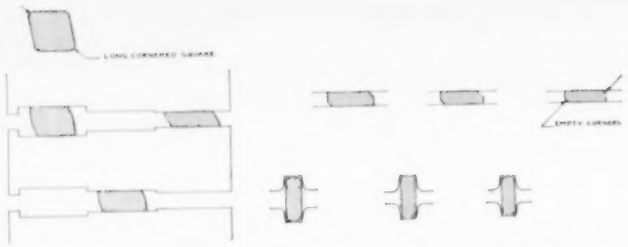


Figure 22 — It is important to have a square with equal opposing diagonals.

on large quantities but it is difficult to use on small quantities due to the amount of time required for adjustment from one size to the other.

UNFILLED CORNERS

When the section is finishing with two sharp corners and two dull corners, the first place to check is the flat entering the first edging. Should the edges be found to be beveled, two of the corners will be empty and will carry through to the finishing pass.

The cause of the beveled edge originates from the square having unequal opposing diagonals and, during reduction of the square in flat passes to $1\frac{1}{16}$ in., the edges become beveled. It is possible to deliver a rectangle with square edges with two of the corners slightly empty. The main cause for this is that the first or second edging can be crossed, which produces a section, entering into the third or last edging, to be off-square. This in turn can cause empty corners.

When all four corners on the finished bar are empty, the usual cause is not enough stock or square to start with. If we assume that the same size has been produced successfully with the size of square being used, it is then necessary to consider the distribution of draught from one edge to the other, the temperature, grade, etc.

ROLLING DIFFERENT GRADES

Practically all the mills are producing flats from straight carbon grades which are usually considered to be the less difficult grades to handle. However, each grade has its peculiar reaction on certain sizes, and roll design plays an important part in obtaining a uniform rectangle. Special methods of designing and turning the edging rolls are used to compensate for the irregular flow of metal on the edge of the bar when going through the finishing pass. Heavy sizes, such as $2\frac{1}{2}$ x $1\frac{3}{4}$ in., require a specially designed convex in the edging rolls to obtain flat edges.

Stainless grades vary in regards to spread, therefore, it is necessary for the roller to compensate for the spread by less stock and less reduction, always maintaining the flats entering the edging to the dimension of the edging groove. Due to the natural increase of spread and flow of the material, corners are usually not difficult to obtain, therefore, less stock and less draft in the edging grooves is required. This is also desirable to assist in eliminating wrinkles, or so-called mechanical seams, collar marks and shearing, the latter causing slivers. Also, mills rolling various grades have to produce them from the same edging groove. This procedure requires the roller to apply the necessary technique to produce a uniform rectangle with sharp corners and edges without convex or concave.

High speed grades are in fact less difficult for the experienced roller. Due to the density of this steel, the outside area that is in contact with the roll appears to flow readily to conform to the shape. The usual percentage of draft can be used, however, heavy drafts, when entering the first edging, are not desirable due to the rolls not biting as readily as steels with less density. The most difficult sections to roll are thin sections, such as $\frac{1}{8}$ in. in thickness x 2 in. and over in width. At this point, the checking of edges is prevalent, especially on certain heats that do not have high forgeability standards.

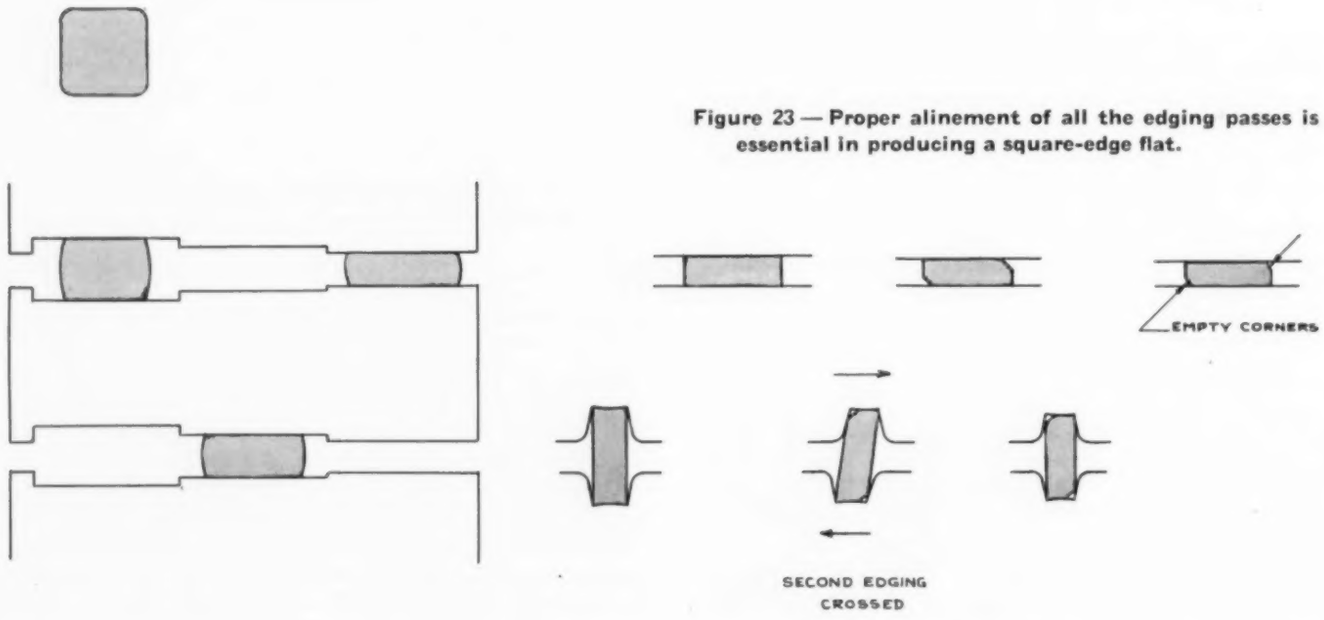


Figure 23 — Proper alinement of all the edging passes is essential in producing a square-edge flat.

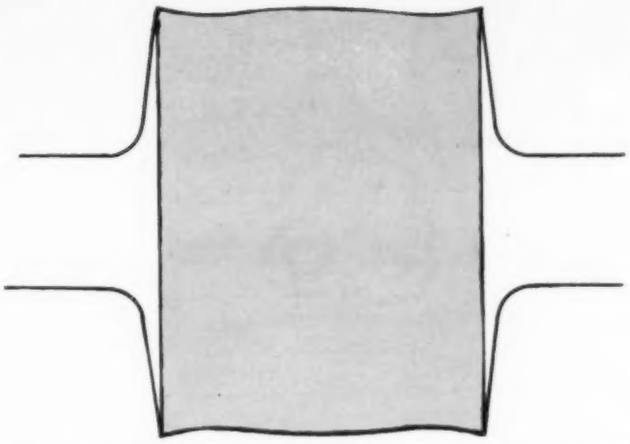


Figure 24 — This type of edging is only required when rolling a heavy section on a small mill.

It is necessary, even with heats of the highest forgeability standards, to use light drafts which can be obtained by starting with a billet that does not require an excessive amount of passes before the final finishing pass, but enough draft to readily clean the bar.

Water on high speed grades is not desirable, especially on flats, as cold rolls chill the corners of the bar and adds to the problem of checking. Large quantities are not usually involved and bars are usually short, therefore, the roll contact time is short and the heat is dissipated at a reasonable rate. However, on large quantities and at a rapid rolling rate, water can be used on the groove but making sure, by packing, that the water is not being carried around the roll and on to the bar.

DEPTH OF EDGING GROOVES

Most mills rolling flats cover a wide range of widths. For example, on the ½ in. thickness, the range may be from ⅝ to 3 in. or even 4 in. wide, depending on the number of mills in the plant.

To produce ⅝ in. widths, the edging cannot be more than $^{9}/_{32}$ in. deep in each roll and, to eliminate roll changes and roll cost, this same groove is usually used up to and including 1¾ in. wide. At this width, the rolls are $1^{5}/_{16}$ in. apart (usual term, off-the-face). Beyond 1¾ in. wide, the problem of preventing shearing has to be considered, therefore edging rolls of a greater depth are used.

Edging grooves for rolling above 1¾ in. widths are usually designed and turned ⅞ in. deep. Here the condition is good up to 2½ in. widths, but beyond this becomes undesirable again and the producing of bars becomes difficult. The most desirable and less hazardous condition is to have the various lines of edging grooves designed and turned, so that the minimum coverage of the bar will be two-thirds of the width. For example, when edging a 3 in. flat, the edging would be 1 in. deep in each roll.

GUIDE ASSEMBLY FOR STEP AND EDGE METHOD

The entering guide box for narrow widths must be of a rigid design, with machined-finished surfaces to facilitate the proper alinement and setting of the buttons or

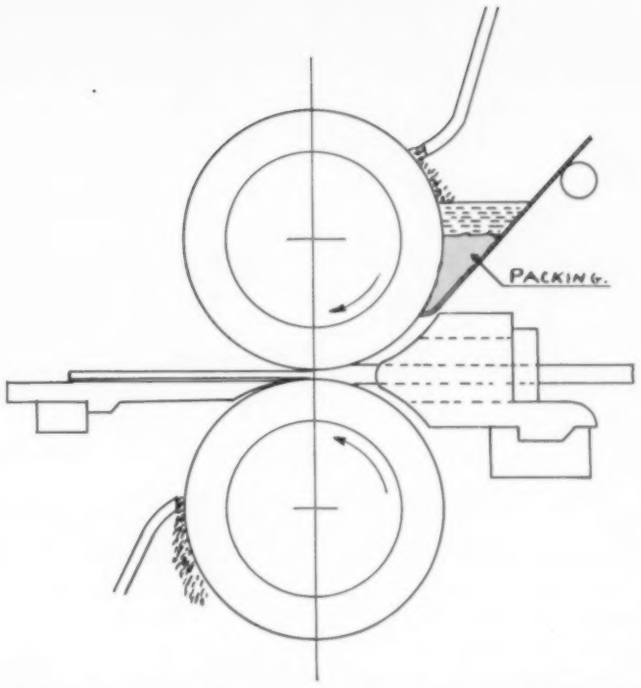


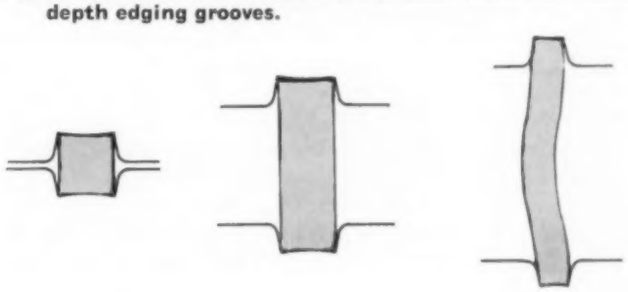
Figure 25 — Roll cooling assembly to prevent water from spraying on bar.

liners in the box. The height of the box and guides should be in proportion to the width of the bar. Wide sections require less support from the entering guides, due to the deep edging grooves which assist in supporting the bar.

To facilitate quick changes, the assembly should be designed so that the entry box can be moved easily from one groove to the other. The rest bar should be placed on the outside of the housing with adjusting screws to assist in raising and lowering the rest in a minimum of time. This is important, as several widths are obtained from one edging groove, therefore, rapid changes and adjusmtents reduce the down-time of the mill.

Delivery guide assembly is equally important, having sideguards of sufficient height to permit the space between the bottom guide and the top guide (hanging guide) to be readily adjusted in accordance with the width of the flat being delivered. Sideguards are usually made of cast iron to assist in preventing scratches; also, rollers can be placed on the outside end which prevents the bar from wearing a groove in the sideguard. This roller aids further in the prevention of scratches. Delivery guides made of cast iron are satisfactory from the standpoint of preventing scratches, but lack strength, and therefore guides made of steel or an alloy material

Figure 26 — Various widths are obtained from the same depth edging grooves.



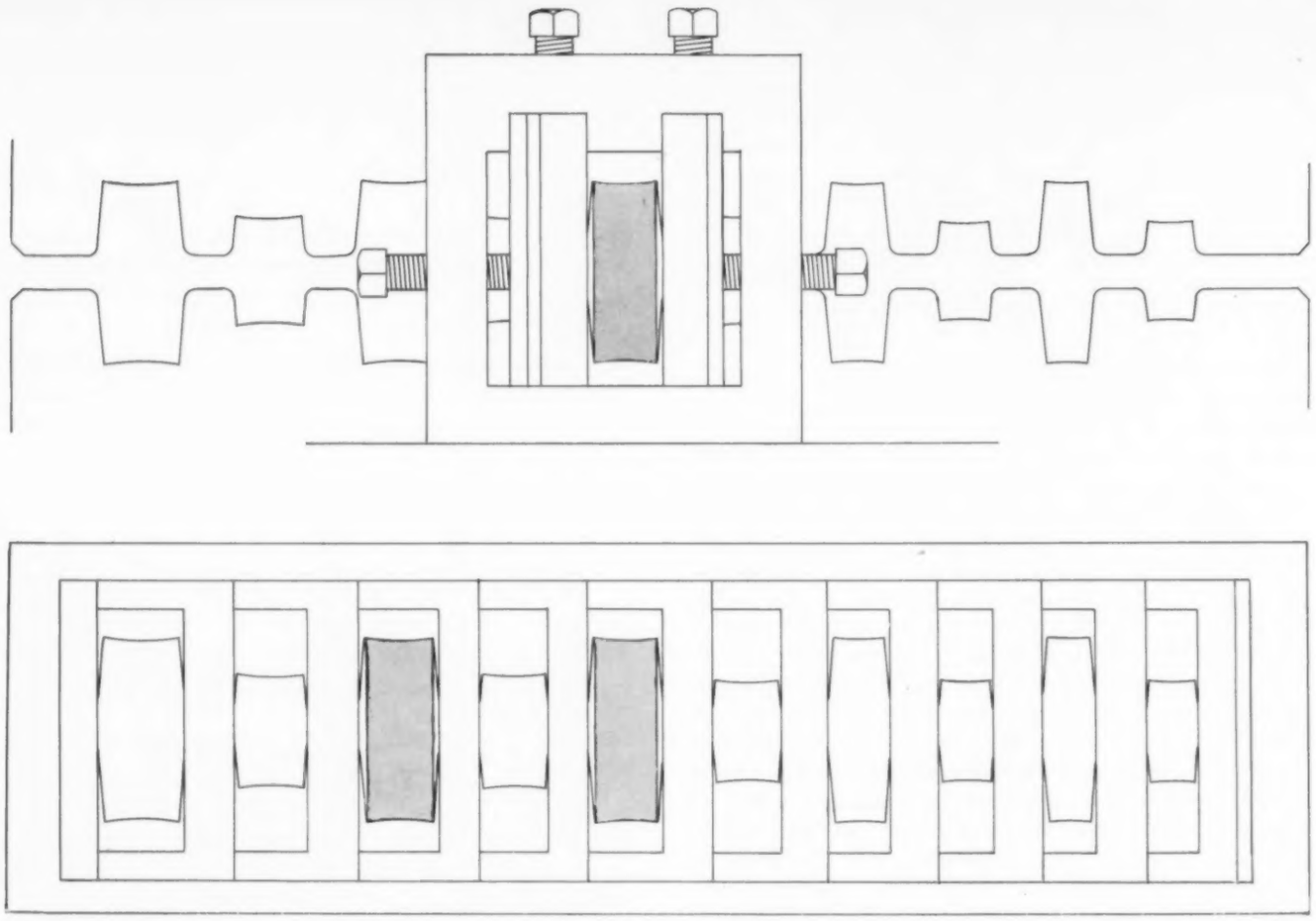
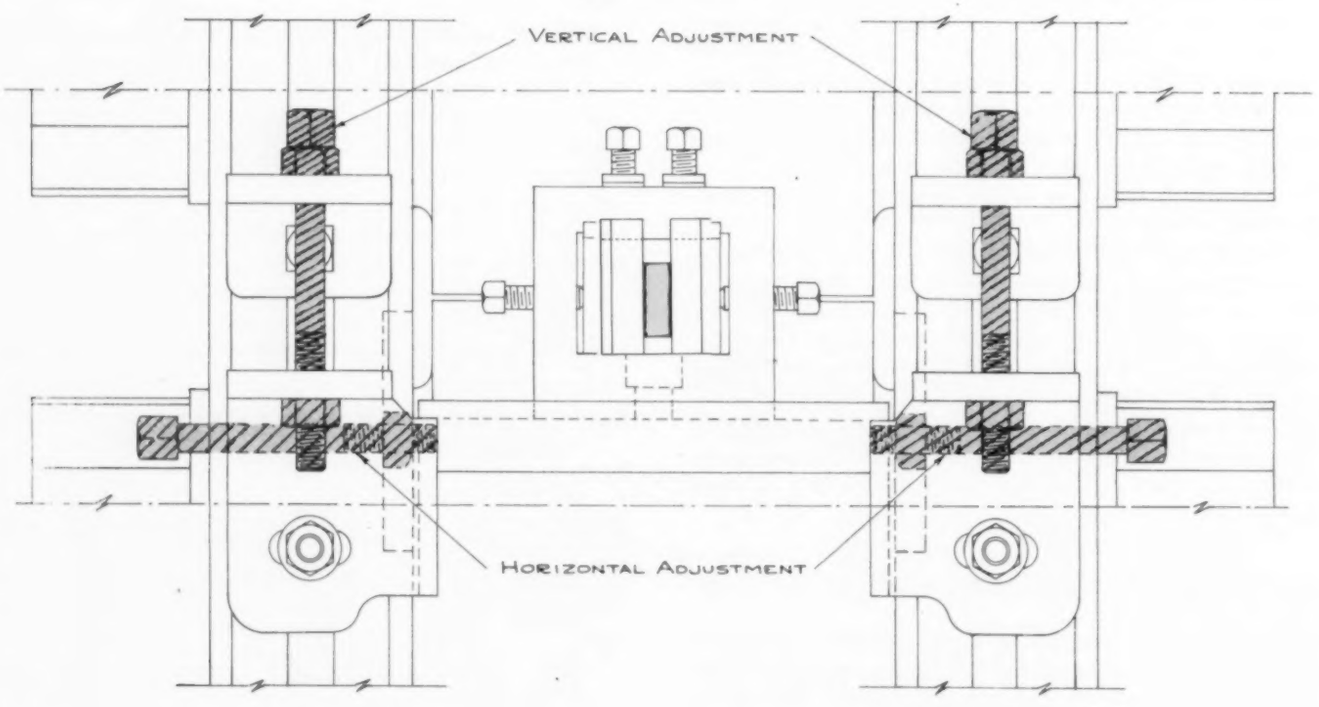


Figure 27 — On top is an entry guide box assembly, and on the bottom is a full length solid entry box.

are generally used. The use of a roller placed at the heel of the guide, set slightly higher than the bottom guide, relieves the pressure on the delivery guide and assists in preventing scratches.

Figure 28 — Entry guide assembly with a lateral and vertical screw adjustment will aid in a more perfect pass alinement.



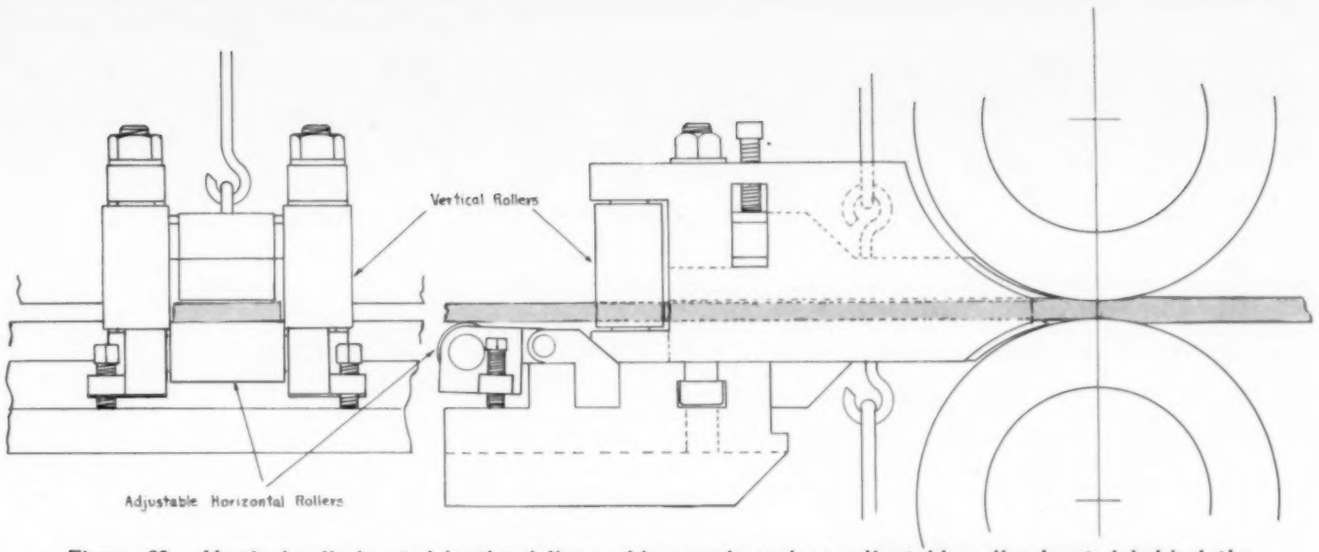


Figure 29 — Vertical rolls located in the delivery side guards and an adjustable roller located behind the stripping guide are being used successfully in eliminating scratches on the finished bar.

ROLLING TECHNIQUE

The rolling procedure and technique to produce flats, especially on mills that are required to produce a wide range of sizes and grades consisting of carbon and alloy steels, have many variables.

The roll designer aims to design and turn the rolls to produce as many widths as is practical for one edging groove. For example, a 0.562 in ($^{9}/_{16}$) groove is designed and turned to produce flats from 0.750 in. in width, to 1.750 x 0.500 in. in thickness. Each width presents a different problem in regards to producing a flat without convex or concaved edges. The 0.750 in. width will deliver from the edging, slightly convexed on the width. Due to the small area of the section, this convex or extra metal in the thickness will force convex into the edges. The roller can overcome this by reducing the stock previous to the last edging. The action or flow of metal will vary as each width is produced and adjustments have to be made to proportion the edging draft in accordance with each width desired. In producing 1.750 x 0.500 in. flat, it is necessary to proportion the draft accordingly when using an edging that is $^{11}/_{32}$ in. deep in each roll, as the rolls are $1^{1}/_{16}$ in. apart. The metal will fill the edging to the degree of opening and a bulge will be formed, about $^{11}/_{32}$ in. from each edge of the bar, however the middle of the section will be concaved. Each grade, in this range of widths, requires a change of draft on the width to produce the rectangle.

The roller applies the technique he has acquired over a period of years. The ability of a good roller cannot be neglected when producing a range of rectangles and various grades in the one design of the groove. Roll pass development has been brought about over a period of years through trial and error. When producing all grades of steel, the roller instinctively recognizes the action and flow of the different grades, also the effect of high and low temperatures. There are numerous instances on each section of roll setting adjustments necessary to produce a good product.

It is important for the roller to keep the roll designer informed of the action or flow of metal in the different passes. This can be done by providing the roll designer with sections from each pass. This provides the designer with information that may assist the roller in producing a better product with less effort.

Each mill in a plant, even though producing the same or similar sections, requires a slight difference in roll design, proportioning of draft from one pass to the other which is caused by roll diameters, mill speeds and grades produced. The roller, by close observance of the mill conditions and the passing-on of information immediately to the roll shop, can improve the conditions and the product. Also, he will derive the personal satisfaction in the improvement made.

DISCUSSION

PRESENTED BY

W. F. SCHUPP, Chief Draftsman, Bethlehem Steel Co., Lackawanna, N. Y.

CHARLES P. HAMMOND, Superintendent Rolling Mills, Atlas Steels Limited, Welland, Canada

W. F. Schupp: In regard to safety guide you mentioned in your paper, do you think it necessary to have such an elaborate set-up for a safety measure?

C. P. Hammond: Yes. We think it is well worth the expense as a safety precaution.

W. F. Schupp: Under the caption of rolling of flats, do you not find that if you have plain rolls in your leader, that the bar will tend to go diamond?

C. P. Hammond: Not if you hold it up and make a uniform fluted square.

W. F. Schupp: Would it not be safer to put an edger pass in it?

C. P. Hammond: You will find tool steel plants and plants handling stainless that prefer to use the plain rolls for edging due to the fact that stainless shears very easily, and on a narrow bar you have a shallow edging. Therefore, your chance for shearing or marking the bar is more prevalent. However, for ordinary flats and long bars I do not recommend that plain rolls be used, as you do have more difficulty maintaining a square bar, but it is surprising how good a job you can do with the proper fluted square. If you start right you will not have any trouble making a square bar on plain rolls.

Air Conditioning of Crane Cabs

. . . . crane cab air conditioning provides a satisfactory and economical method for reducing in the cab the dust, fumes, and gases in which some cranes must operate . . . .

By RICHARD D. DARRAH
Dravo Corp.
Pittsburgh, Pa.

▲ AIR conditioning of crane cabs has come to be recognized as a highly specialized field, not just because of extreme temperatures, dust and dirt, and fume conditions which are encountered, but also because the air conditioning equipment itself must be designed to stand up under and operate efficiently in these extremes.

A complete discussion of the subject requires the consideration of all phases of the problems to be met and the various methods and means of meeting them.

The first consideration, generally, in air conditioning a cab is what temperature and relative humidity is found at the crane operator's level. Table I represents an effort to associate temperature and humidity with various types of crane operation. Some deviations from these figures have been recorded, as certain factors such as plant orientation to prevailing winds, and the amount of open wall area of a building, will definitely effect interior conditions. However, the figures in the table are based on a considerable number of actual recordings, and may be considered safe in furnishing the information required to calculate the sensible and latent heat which must be removed in order to maintain normal conditions within the cab.

High ambient temperatures as indicated on Table I are known to affect the human body functions and processes which strive to control body temperatures. These

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TABLE I

TEMPERATURE CONDITIONS

Type of crane operation	Ambient temp, dry bulb, F	Ambient temp, wet bulb, F	Relative humidity per cent	Grains of moisture	Body temp, F
Soaking pit Coil storage	160–170 164	94	7.8	128	
Ladle (open hearth pit side) Forging furnaces	150–160 156	92	7	125	
Foundry (large castings) Charging (open hearth) Electric furnace Cupola charging	140–150 146 142	88 86	11 10	108 105	102.5 102
Ladle (small capacity) Pickling (over open vats) Aluminum reduction Aluminum remelting Copper smelting Annealing furnace	125–140 138 130	83 81	10 12	83 82	101.6 101
Cement production Lead production Glass making Brass and bronze casting Steel and iron casting (small) Galvanizing mill Vanadium production Manganese production	100–125 120	80	18	90	99.6

The specific temperatures, relative humidity, etc., given for the various temperature ranges represent averages of numerous recordings taken by the author and do not necessarily apply to the crane operation directly opposite.
Normal body temperature is 98.6 F — Temperature ranges are based on 175 recordings.

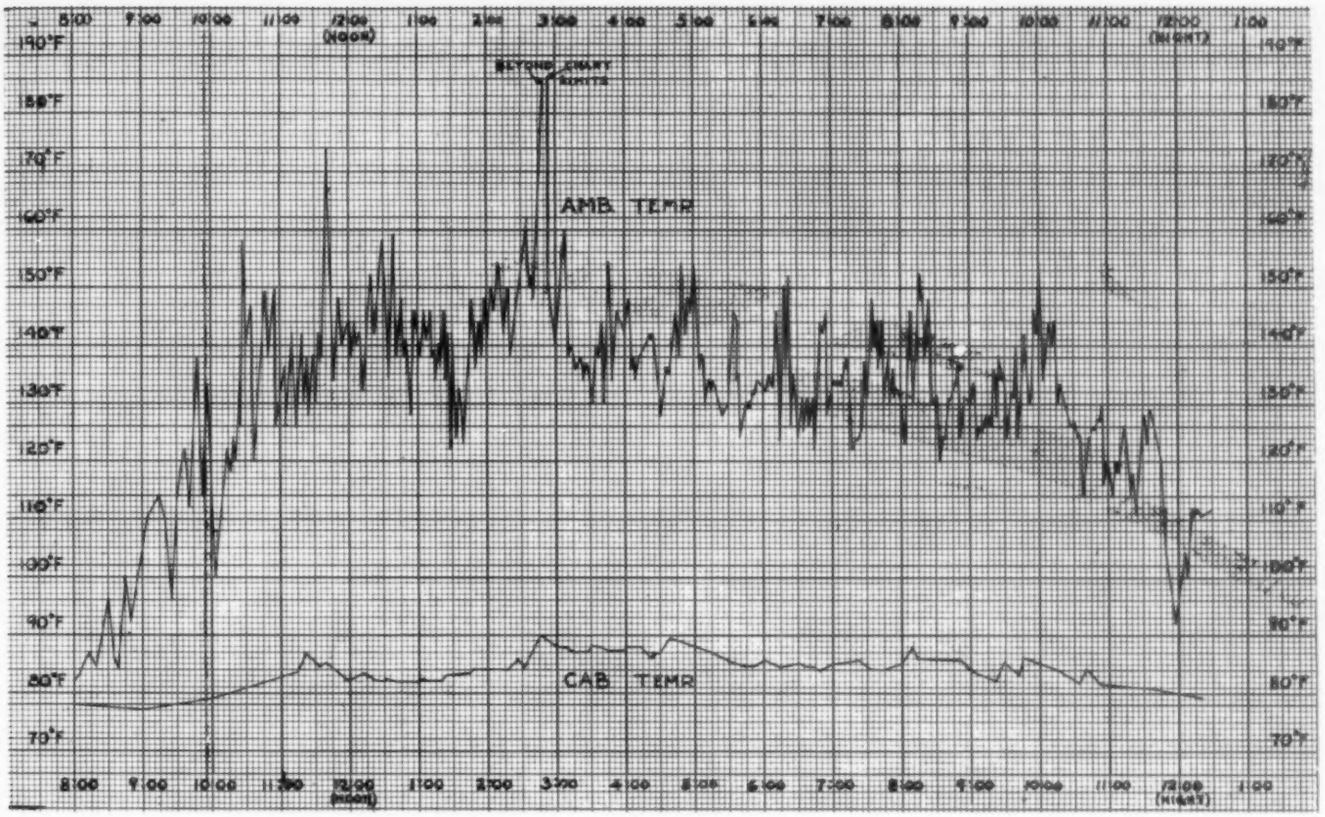


Figure 1 — Temperature records on both inside and outside the crane cab of a soaking pit crane are given by this chart for a period of 16 hours.

mechanisms are, first, regulations of internal heat production which is a chemical regulation and second, regulation of heat loss by means of automatic variation in the rate of cutaneous circulation and operation of the sweat glands. The body temperatures indicated were taken to try to determine at what ambient temperature the evaporation of body perspiration ceases to take care of heat production, plus radiation and convection gains. When this particular condition takes place, the body starts to take on heat from the surrounding atmosphere and the human body temperature rises.

Actually, a crane operator working in high ambient temperatures is subject to artificially induced fever. When body temperature rises progressively to 102 F, a man will continue to work fairly efficiently. When these temperatures are exceeded, men work at quickly declining efficiencies and are liable to heat exhaustion, heat cramps, fatigue and headaches. Around 104 F a person is subject to mental disturbances, apathy to a situation and poor judgment.

One preventive measure for decreasing the amount of time the crane operator is exposed to these conditions is by employing relief operators or spellhands, who alternate over regular time intervals in relieving a crane operator. However, the only way of reducing such temperatures to normal comfort standards is by mechanical refrigeration. Normal comfort conditions are 80 to 85 F inside the cab.

Figure 1 is an actual temperature recording of conditions surrounding the cab and also inside a cab which operates over a soaking pit. The great surges shown indicate the great amount of radiant heat to which the operator is subjected in this operation. Note also the slight variations in the cab temperature. At these cab temperatures, the human body has no difficulty in maintaining a heat balance, and working efficiencies, interest, judgment and morale are at their peak, thus permitting one crane operator to work a full eight hour shift.

Dust and dirt at the crane level, generally present a nuisance condition which is primarily due to the unusually large quantities in the atmosphere. Various tests have indicated that most dusts in the steel industry do not contain any one particular constituent in sufficiently large quantity to be considered a health hazard. Slag dust, sand fines, ferric oxide, earth dust, manganese particles and coke dust are the basic constituents of these dusts. There are some exceptions such as in foundries making large sand (silicosis) castings, and the non-ferrous industries (lead, copper, zinc, cement) where dusts do present a health hazard. Annoyances from dust are manifested by eye irritations, respiratory complaints such as hoarseness, sore throat, coughing. Viscous, cleanable impingement type filters, or cotton or wool bag filters will remove dust and dirt to a low enough concentration that no irritation or annoyance exists.

Fumes, mists and gases can present a hazard to health when considering crane operations. Table II lists most of the irritants found in the atmospheres of the metal industry, with their maximum allowable concentrations. These quantities are those recognized by several authorities on the subject. All are computed on the basis of an eight hour working day. The figures in the

TABLE II
MAXIMUM ALLOWABLE CONCENTRATION
GAS — VAPOR — MIST — DUSTS

Material	ppm	mg/m³
Anthracene	Not determined	
Acridine	Not determined	
Acrolein (acrylaldehyde)	0.5	1
Arsenic	..	0.15
Arsine	1	2
Bromine	1	5
Cadmium	..	0.1
Carbon disulfide	20	50
Carbon monoxide	100	100
Chlorine	5	10
Chromic acid	..	0.1
Dichlorotetrafluoroethane (freon — 114)	10000	50000
Fluoride dusts, smokes	..	2.5
Hydrofluoric acid	3	..
Hydrochloric acid (hyrogen chloride)	10	10
Hydrogen cyanide	20	20
Hydrogen fluoride	3	2
Hydrogen selenide	0.1	0.2
Hydrogen sulfide	20	20
Iron oxide	..	15
Lead	..	0.15
Magnesium oxide	..	15
Manganese	..	6
Mercury	..	0.1
Nitrogen oxides	25	100
Ozone	1	2
Selenium compounds	..	0.1
Phosphine	1	1
Sulphur chloride	1	5
Sulphur dioxide	10	25
Sulphuric acid	..	5
Tellurium	..	0.01
Zinc oxide	..	15

first column refer to parts of gas or vapor per million parts of air by volume, ppm, and the second column gives the round number equivalent of these limits in milligrams of substance per cubic meter of air (mg/m³).

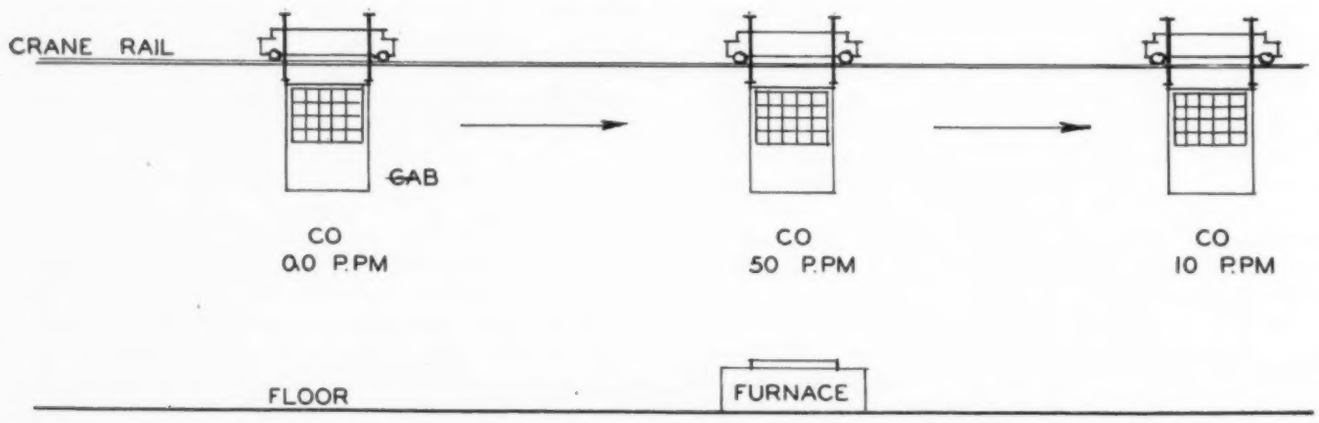
These values are tentative values based on industrial experience, animal experimentation, sensory responses of persons, or a combination of these, and are suggested as guides to be used in determining peak limit conditions.

The majority of these vapors and gases listed are irritants and general poisons. Irritants being those gases and vapors which might cause inflammation of the skin, eyes, or respiratory track; poisons, those that produce remote, usually systemic poisoning rather than local effects. Other gases and vapors such as carbon monoxide, various cyanide compounds are asphyxiants and do no direct damage to the lungs, but induce asphyxiation by interfering with the supply of utilization of oxygen in the human body. One particular gas is indicated on that chart to show the comparative toxicity of this particular gas to those found in the various phases of the production of metals. This particular gas is dichlorotetrafluoroethane, freon-114, and is the refrigerant used in crane cab air conditioning equipment. It is quite evident from the comparison why freons are considered non-toxic. It would be impossible, even with a breakage of refrigerant lines, and with all the refrigerant being introduced into the cab, to produce the high allowable concentration. For that reason, no health hazard exists from the use of freon-114 in crane cab air conditioning.

These gases listed merit individual discussion. The first of these is sulphur dioxide. This irritant occurs widely in many types of operation in the hot metal industry and might even be considered the most frequently occurring; with a maximum of ten parts per million, it can represent an impairment to health. Fortunately, it is easily detected because of the distinct pungent sulphur odor, quite perceptible to the sense of smell. This particular irritant in many instances has been the chief cause of irritations to the mucous membrane of the nose, is a contributing factor to digestive disturbances, causes irritations to the eye and to the respiratory tract, which can lead into further complicated disturbances.

Ozone, with a maximum allowable concentration of one part per million, is not too commonly found around crane cab levels, and when it is found, it is due to the arcing of electric contactors, particularly of the rheostat type, of crane cab controls. In one particular case in the writer's experience, a complaint of carbon monoxide was received, when actually the concentration was so low that it was negligible, but a distinct odor of ozone was present. Upon investigation, the source of the ozone was located, the concentration was sufficient to cause headaches, eye irritations, and stomach disorders which resulted in absenteeism on the part of the operator. The removal of these particular controls to another location eliminated this particular grievance.

Figure 2 — Air conditioning of the crane cab also dilutes the gases inside the cab which are not affected by the filtering mediums.



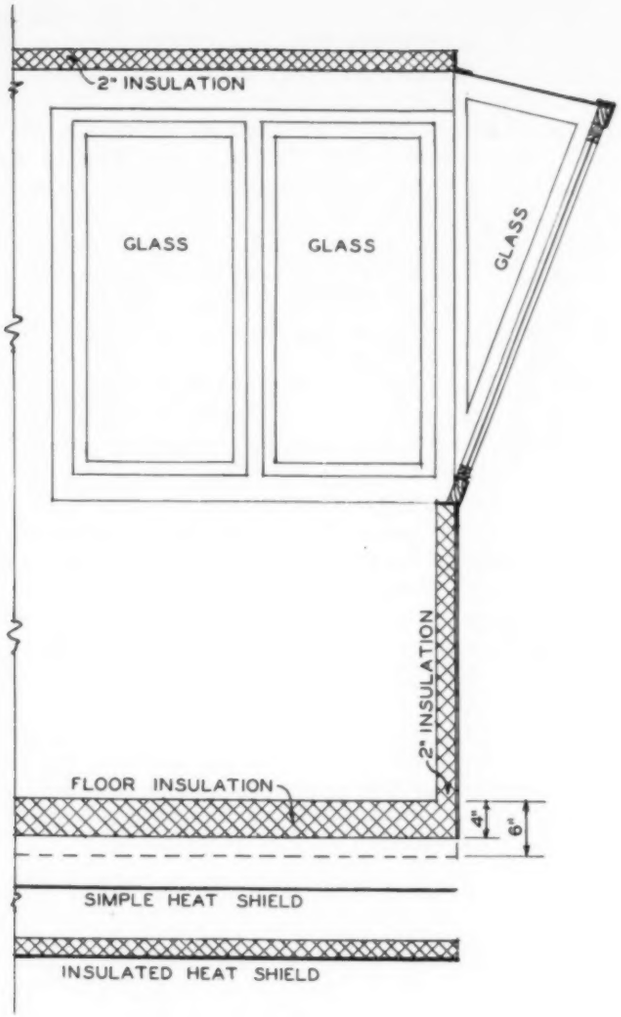


Figure 3 — Typical crane cab insulation is illustrated in this figure.

Activated carbon as provided in the crane cab air conditioning units made by the writer's company will reduce the concentration of the above listed gases and vapors considerably below the maximum allowable.

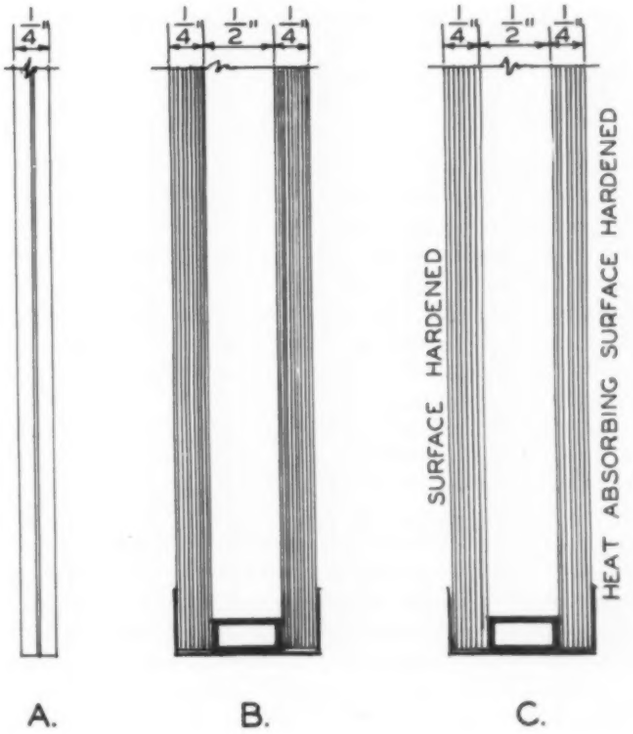
Carbon monoxide appears to be the most feared gas, and this fear is due to the fact that its presence cannot be detected by any odor or sense of smell, even though the maximum allowable concentration is 100 ppm or ten times as great as sulphur dioxide. Activated carbon in any form will not adsorb this particular gas and, unfortunately, today there appears to be no small mechanical pieces of equipment which can cope with the various concentrations. However, the air conditioning of a crane cab does very definitely provide a dilution of the concentration inside the cab. Figure 2 diagrammatically explains this dilution. A continuous supply of air is provided in the cab, 25 per cent of which is makeup air. As the crane moves from the portion of the plant where no carbon monoxide exists, closer to the source of the carbon monoxide, concentrations are introduced into the cab but diluted by 75 per cent recirculated air, with the results that after continuous operation it was found that the air in the cab had a concentration of only 10 ppm, whereas in the atmosphere at the crane level over the furnace, the carbon monoxide concentration was 50 ppm. This represents an 80 per cent reduction. These actual tests were conducted by an independent testing organization called in by the management of the company in which this installation was made, for the purpose of determining the various carbon monoxide concentrations with and without air conditioning.

In reviewing the various unusual conditions found at the crane operator's level as discussed herein, there are a few facts which should receive considerable thought. First, the morale of a crane operator who is completely fatigued and suffering from exhaustion at the end of a day is very low. Second, a man cannot be too content if he works or is exposed to objectionable concentrations of irritating materials. Third, chronic occupational illnesses can be and have been caused by repeated exposures to low concentrations of toxic materials, frequently so low that they are not in the least objectionable to the worker.

In endeavoring to counteract the extreme heat conditions, it is necessary to give consideration to the design and construction of the crane cab itself.

Figure 3 indicates what might be considered typical crane cab insulation, and is adaptable to an existing cab or a new cab. The ceiling and sides of the cab should be insulated with a minimum of 2 in. of standard insulation. It has been the general practice to make the outside surface of the side walls a light gage steel plate, and the interior surface a non-metallic hard surface board. The floor of the cab should have a minimum of 4 in. of insulation, and preferably 6 in. Where large quantities of radiant heat are experienced, such as over soaking pits and certain types of ladle cranes, it is highly desirable to suspend a heat shield 2 or 3 in. below the insul-

Figure 4 — Three types of window glass have been commonly used for the cab windows.



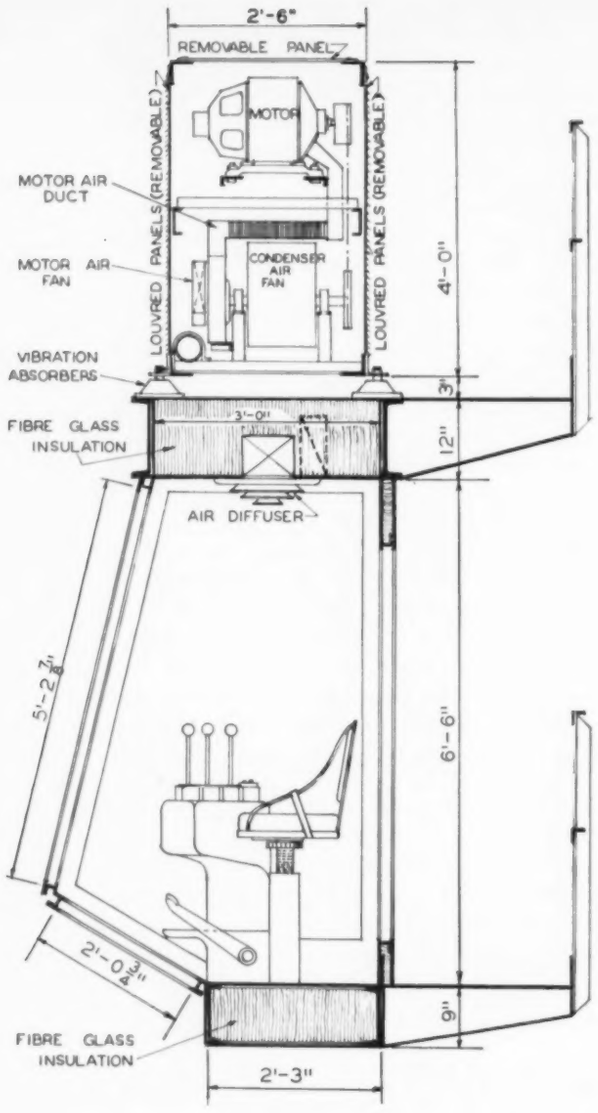


Figure 5 — The cab shown uses a heat absorbing case hardened window glass.

ated floor of the cab, and under these conditions, the floor of the cab should definitely have 6 in. of insulation. A heat shield is highly effective, because it will heat up very quickly, and as the crane moves, air currents pass along and wash both surfaces of the shield, thus removing a large portion of the heat from the shield. The effectiveness of the shield in decreasing heat transmission through the insulated cab floor is approximately 30 per cent.

Due to the various requirements of vision in the cab, it is necessary to carefully consider the types of glazed windows which are most desirable for the cab operation. Three types of glass, Figure 4, have been used for windows and are discussed individually. The first, type A, is ¼ in. safety glass, which consists of two pieces of glass laminated to a plastic core. This particular type of glass is very desirable because, although it will crack, it does not shatter into fragments. Where comparatively small windows are required, it is highly recommended. Where fairly large expansive windows are desirable, type B, the hermetically sealed, double glazed window with an air space between two ¼ in. pieces of plate glass is most effective, as the air space between these two pieces of glass acts as an insulator. Where a full side of the cab is used as glass area, type C, heat-absorbing, surface hardened glass constructed in the form of a hermetically sealed or double glaze window should be used. Figure 5 is an example of the use of this heat-absorbing case hardened glass. All sides of the cab are glass from floor to ceiling. The exterior glass pane is surface hardened, heat-absorbing type and the interior pane is surface hardened glass which is four times as strong and flexible as ordinary plate glass.

The front wall is sloped outward from the floor line so that the operator's line of vision when he looks down would be perpendicular to the slope of the window.

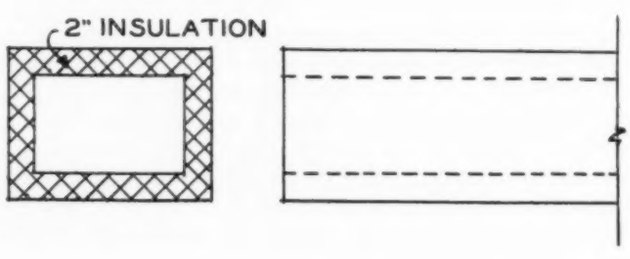
Regardless of the particular design of the cab, consideration should be given to locating an air diffuser in the center of the ceiling if at all possible. The primary purpose for this is that the air supplied to the cab should actually wash the surfaces of the walls and floor of the cab, removing the heat as it is transmitted through the sides and floor. Consequently, the crane operator would not be in a direct path of the air stream supplied. The return air opening should be placed close to the floor of the cab, and for the sake of economies in duct insulation, the return duct can also be placed inside the air conditioned cab. This will save the necessity for insulating the return air duct until it extends through the ceiling or one side of the cab to the hot atmospheres.

All ducts exposed to high temperatures carrying supply and return air from the air conditioning unit to the cab should be insulated with 2 in. of standard insulation. It is suggested that these ducts be so constructed Figure 6, that, in effect, a hollow wall duct is made, the opening between the two ducts being filled with the necessary amount of insulation. This will prevent the insulation from being shaken loose from the ductwork, and will make a very rigid, strong construction which will withstand a considerable amount of shaking and rough abuse.

Figure 7 shows a dust filtering unit made up of wool bags with a shaking device. It is recommended that the wool bags be made sufficiently large so that one square foot of surface of wool bag will handle no more than four cubic feet of air per minute. With this design condition, a resistance of three and a half to four inches water gage should be figured through the filtering unit.

The filtering efficiency of this material is lowest when it is new, occasionally reaching as low as 80 per cent. However, collected dust forms its own filter and after this filtering unit has been in operation for a short while,

Figure 6 — Ducts should be preferably insulated with 2 in. of standard insulation.



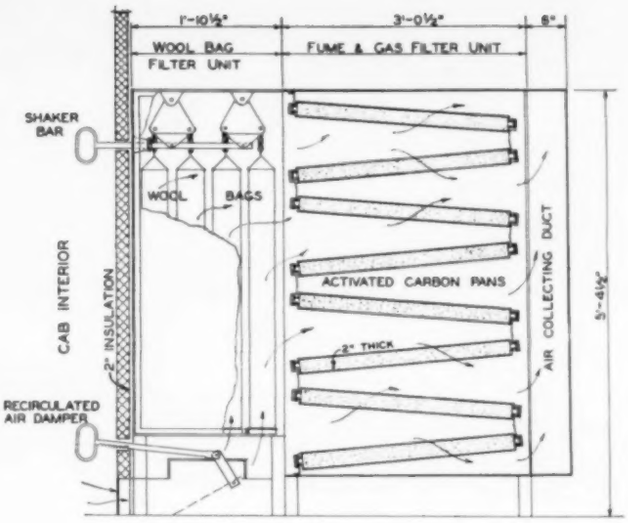


Figure 7 — A shaking device is used to aid in cleaning the wool bags used for the dust filtering unit.

efficiencies as high as 99 per cent are reached when removing particles even as small as 0.5 microns. The air is introduced at the bottom of the bag and is drawn upward toward the top of the bag being pulled through the sides.

In cleaning this filter, a shaking device is used which permits the crane operator to shake the various bags vigorously, thus loosening the dirt. The wool is strong enough (10.5 ounces) to take this rough usage and will last for a number of years. It can be seen that the one particular disadvantage of using this type of dust and dirt filtering unit on crane cab air conditioning is the comparative large amount of space required for its installation.

The filtering unit is shown as being connected to bed or pan type carbon fume and gas filters. These beds are arranged in a sloping direction so that the air as it is pulled through the wool bag filters has ample surface area of carbon to pass through. These pans are so arranged in a frame that by opening the side door they can be slipped out, the carbon removed from each individual tray and refillled with new filtering material.

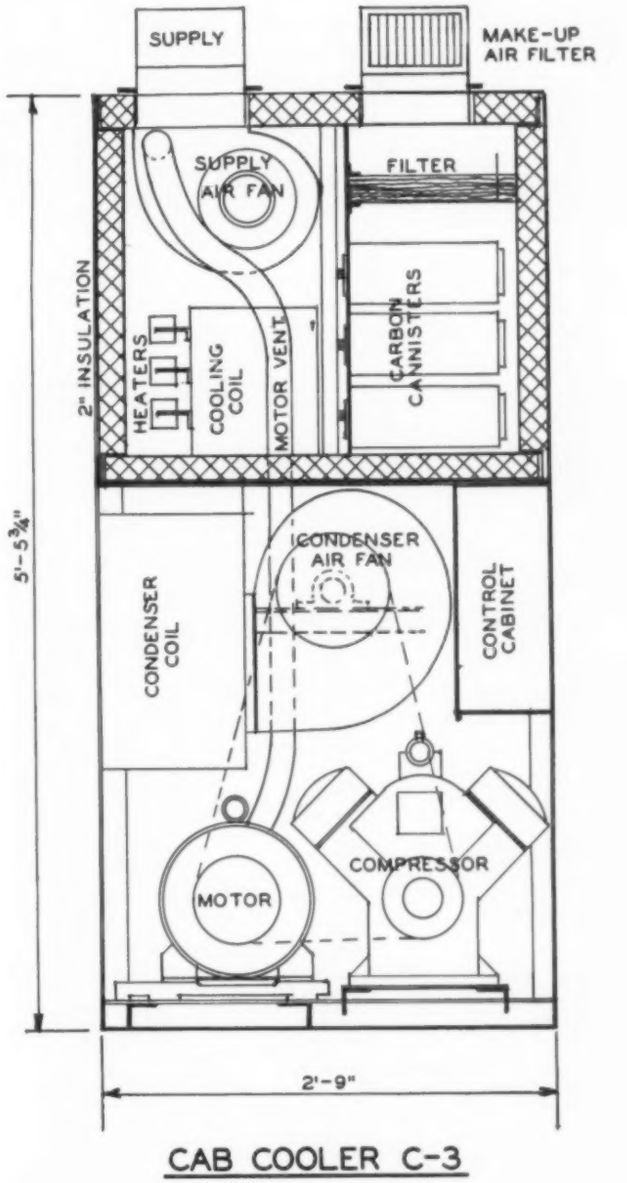
Here again, this particular type of gas and fume filter occupies a comparatively large floor area, which quite frequently is not available in air conditioning a crane.

One point must be made in particular, whenever activated carbon or charcoal is used for the filtering of gases, fumes and vapors, it is necessary that dust filters of some type be placed ahead of it. Otherwise, dust will coat the activated carbon and considerably reduce the carbon's ability to adsorb contaminants. With the pan type fume and gas filters, 2 in. thick, design capacity should be on the basis of six to eight cfm per sq ft of filtering surface.

Figure 8 shows the normal filtering system offered for the reduction and elimination of dust, dirt and fumes and gases. A primary filter is installed in one side of an elbow through which the makeup air passes. This in turn combines with return air and together they pass through a secondary filter directly in front of the activated carbon canisters. The system of using two filters in series, so to speak, represents an efficiency of approximately 95 per cent due to the fact that both makeup air and recirculated air are being filtered continuously.

The particular arrangement of installing a filter on one side of the elbow permits very easy access to the filter which plugs up more quickly, and consequently requires frequent changing. In some instances this filter has been changed daily, whereas the secondary filter has been allowed to remain for two weeks without clogging sufficiently to prevent an ample quantity of air through it. This particular filtering arrangement is common to both sizes of crane cab air conditioning units made by us. Downstream from the secondary filter will be found a bank of activated carbon canisters. These canisters are closed on one end and consist of a hollow cylinder with approximately a half inch side wall. This side wall is really a hollow partition filled with activated carbon granules which have been vibrated so as to pack uniformly and evenly throughout the entire wall surface areas. The inner and outer linings of the filters are pierced with fine holes which permit the air to pass through the side walls, leaving the canister at the open

Figure 8 — The filtering system reduces the amount of dust, dirt, fumes and gases.



CAB COOLER C-3

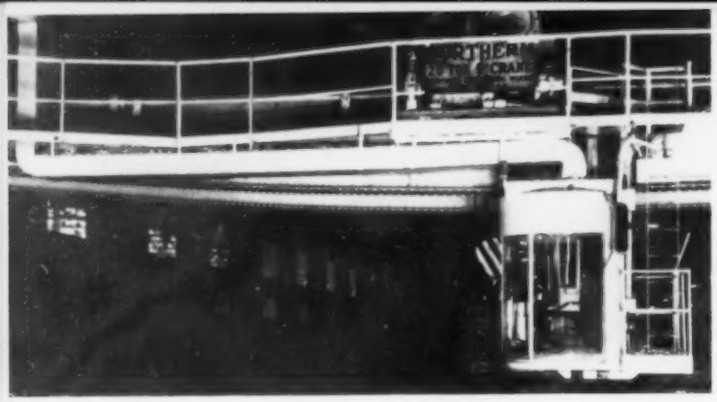


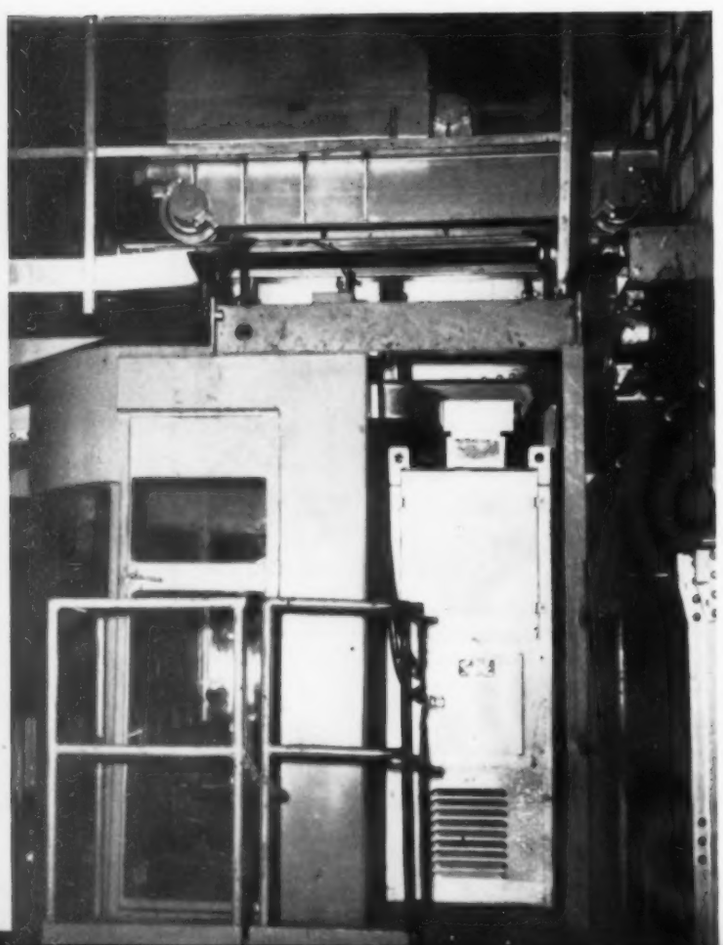
Figure 9 — Placing the air conditioning unit at any distance away from the cab results in long relatively expensive duct work.

end where it is attached to a manifold plate. The air passing out through the open end passes over the cooling coil.

It might be stated that the wool bag filter unit shown in Figure 7 could be used in conjunction with this standard unit by connecting it to the entering air side of the crane cab cooler, or as is being done for one particular company, the combination of the wool bag filter and the bed type fume and odor removal unit together are being connected to the makeup air side of the air conditioning unit, eliminating the standard dust and dirt filter and carbon canisters as indicated here.

After the air has passed through the dust and dirt filters, activated carbon canisters and over the cooling coil, it is supplied to the crane cab by means of the ventilating fan. Note that this fan is a direct connected fan

Figure 10 — By installing the cooler next to the cab itself, most of the duct work is eliminated.



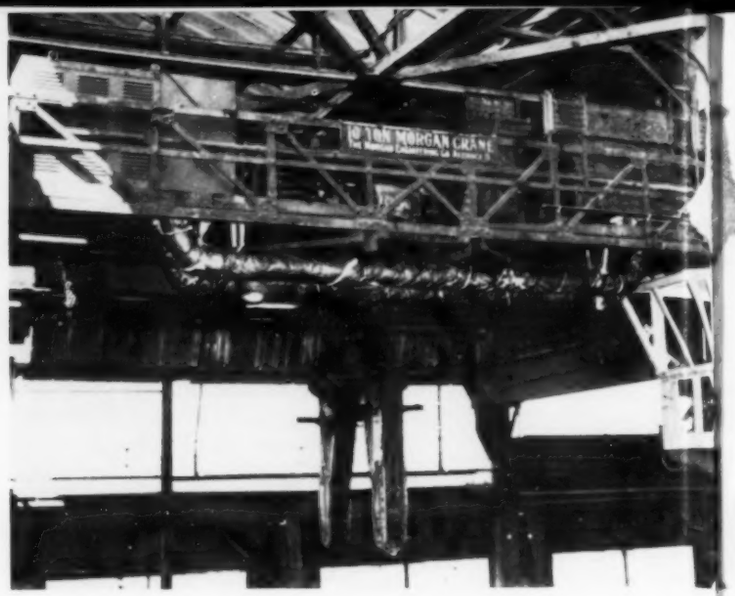


Figure 11 — Resistor and other panels on the bridge may necessitate placing the cooler at a location which is undesirable from a duct work standpoint.

with the motor in the cool air stream. This permits the ventilating fan motor to operate in 60 to 62 F air, and prevents motor from overheating. Approximately 400 cfm is discharged into the cab, 25 per cent of which is makeup air. This amount of makeup air is considerably more than is required by the crane operator for proper ventilation, but is necessary in order to pressurize the cab and prevent infiltration of dust and dirt, fumes and gases. Electric strip heaters are installed directly in front of the cooling coil, which cut in during the winter heating season and temper the air supplied to the cab so that temperatures of 68 to 72 F can be maintained continuously. During the winter heating season of course the refrigeration cycle is cut out.

The crane cab units made by us are air cooled, i.e., air is used for condensing the refrigerant and no water is required in any way for the complete operation of these units. A large, double inlet, double width squirrel cage fan pulls air through louvred panels on both sides of the unit, and discharges that air out across the condensing coil. This condenser air fan is driven by means of belts which also drive the compressor. You will note this is typical of both sizes. The refrigeration motor in the large unit is a 5-hp motor and in the smaller size unit a 3-hp motor. Both of these motors are ventilated with a positive forced ventilating system which provides a quantity of 60 to 62 F air from the conditioning section of the cooler into the motor casing. This cool air has passed through the dust and dirt filters and fume and gas filters, so that dust and dirt and corrosion fumes are removed before the air is discharged inside the casing. This permits the motor to operate in normal temperature conditions, and the freedom from dust and gases permits the brushes and moving parts of the motor to turn over without undue wear and tear and attacks from corrosive gases. It is because of this forced ventilating system that these size motors can be furnished for the performance required of them. Ventilating motors in this way prevents the necessity of using oversized motors of the totally enclosed type. The motors provided with these coolers are standard open type, so that the air discharged into one end of the casing can be expelled out the opposite end.

As previously mentioned, the refrigerant used is freon-114 in preference to freon-12. Freon-114 has a higher boiling point than freon-12, which permits crane cab air conditioning equipment to operate at low pressures in high ambient temperatures.

The controls which permit the crane cab cooler to operate automatically are housed in a dust-tight cabinet with an access door of its own, thus permitting free and easy access to them. One point should be stressed particularly, i.e., that all the mechanical equipment should be readily accessible for quick servicing or maintenance operations. It will be noted from Figure 8 that there is ample space around all items for quick servicing, if necessary. The side panels, through which air for the condenser fan is drawn, are made up of three small individual panels fastened to the structural frame by lugs. By making these panels small, it is possible to handle each section of a panel with little difficulty. The end panels of the conditioning section of the cooler are removable, so that canisters and filters can be reached quickly for changing, and access can be gained to the supply air fan motor.

In order to further illustrate some of the points which have been brought out and discussed herein, it is deemed advisable to discuss a few actual installations.

Figure 9 shows a cooler installed on a crane in a remelt building of an aluminum manufacturer. Notice, with the crane cab in the center of the crane, how much heavily insulated ductwork is required to carry supply and return air. This duct was fabricated in accordance with the construction shown in Figure 6 and represents

Figure 13 — The walls of the cab on this stripper crane are made of glass.

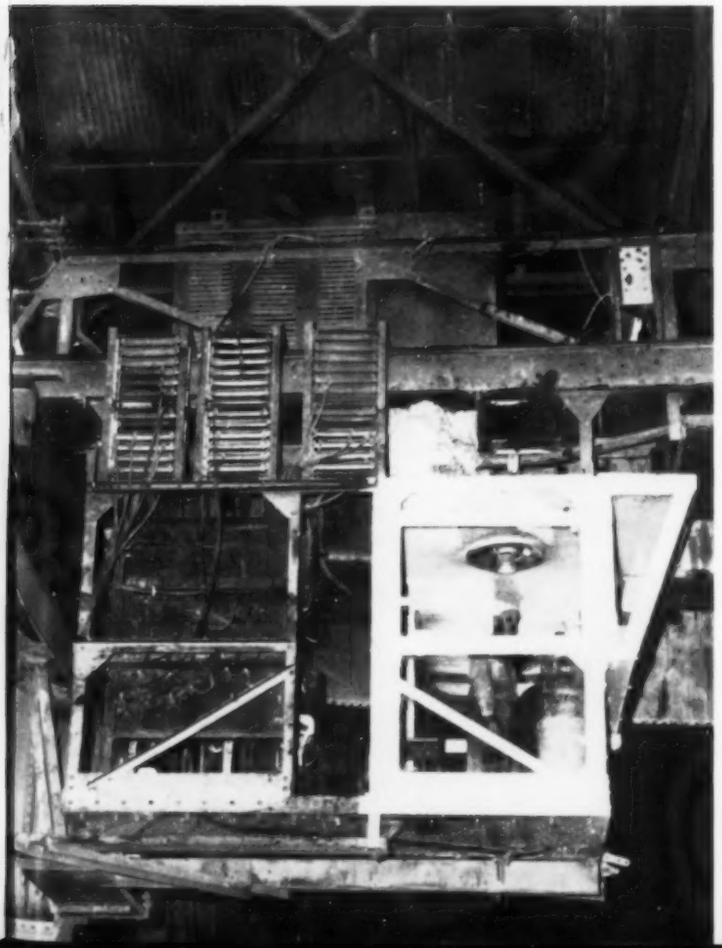


Figure 12 — Compare the duct work on this installation with that in Figure 11.

a fairly expensive installation. Unfortunately, due to the loading stress on the crane, it was necessary to place the air conditioner close to the crane rail end of the crane. Temperatures in this operation reach approximately 135 F.

Figure 10 indicates a more desirable method of installation, with the cooler being installed directly alongside of the cab, requiring only very short ducts into the cab. This particular installation is on a crane operating in a reduction plant of an aluminum manufacturer. Here, hydrogen fluoride and cryolite dusts are encountered and must be removed or reduced in concentration along with cab air conditioning. Temperatures up to 135 F have been recorded for this operation.

Figure 11 is an installation on a foundry crane where it was necessary, due to resistor and control equipment located directly above the cab, to place the crane cab air conditioning unit out in the middle of the crane itself. Again, note the insulated ducts extending over to the cab. Tar fumes from dipping tanks permeated the atmosphere in the casting building, and was a considerable annoyance and nuisance. Tar fumes contain acridine, which produces headaches, eye soreness, and inflammation of the mucous membranes. Being a sand casting foundry, there was a considerable amount of sand, dust and steam which constituted an additional nuisance. Temperatures reach approximately 140 F, and the installation of crane cab air conditioning permitted the crane operator to work in quite satisfactory

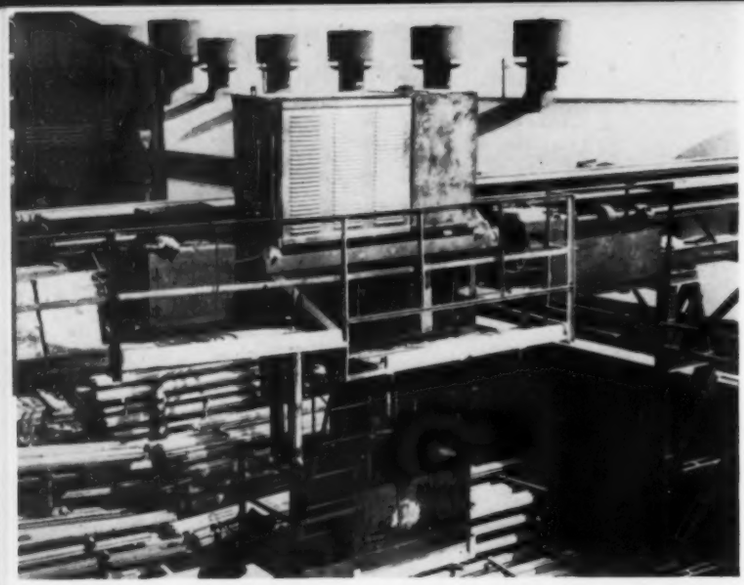


Figure 14 — The data on gas concentrations, given in Figure 2 were taken on this crane.

conditions. The cab itself was enclosed, with the window in the front sloping outward. This feature permits the crane operator to lean out and look directly down in front of the cab for good vision.

Figure 12 is an installation in the same foundry where the air conditioning unit is placed directly over the cab and is a good comparison of the amounts of ductwork required for the two types of installation.

Figure 13 is a picture of a stripper crane cab with glass being used for walls. Figure 5 is a cross-section of this particular cab. Temperatures around stripper cranes reach 135 to 140 F, and due to the considerable amount of open wall area around the stripper building, heat is required during the winter months. This type of cab gives the maximum possible vision, and only the floor of the cab presents an obstruction.

Figure 14 indicates an installation where it was necessary to raise the air conditioning unit above the crane walk due to lack of space, and also because it was necessary to clear the driving shaft, however, comparatively short ducts were required, due to the fact that it was directly above the cab itself.

The carbon monoxide tests which were shown in

Figure 15 — The arrangement of the cooler shown in this crane is considered ideal.

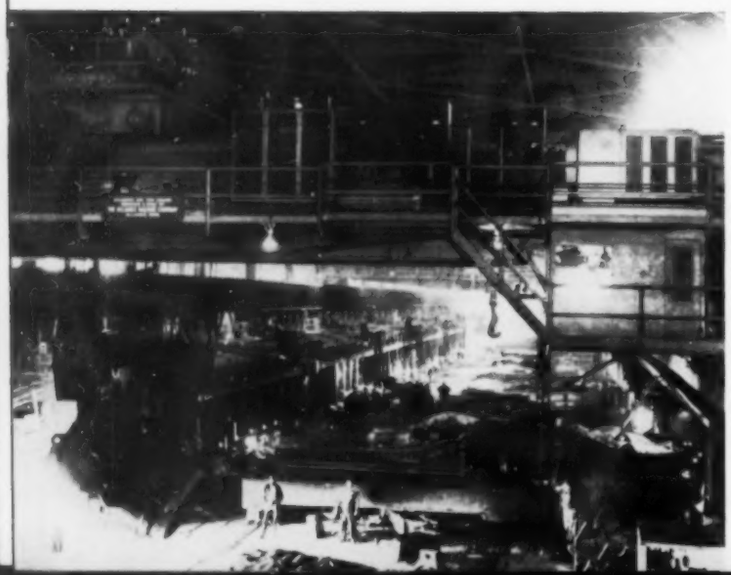


Figure 16 — Cabs of ladle cranes when teeming ingots are subjected to one of the worst heat conditions in the steel plant.

Figure 2 were taken on this particular installation. It happens to be a forging plant crane operating over electric furnaces where some carbon monoxide was present, but dust and dirt and sulphur dioxide were annoyances. Temperatures reached 140 F and air conditioning was felt by the management of this company to be a necessity.

Figure 15 represents what might be considered an ideal installation. Notice the air conditioner directly

Figure 17 — Soaking pit cranes are subjected to very high temperatures.

over the cab itself, thus permitting the entire refrigerating effect of the cooler to be used in maintaining cab temperatures. This particular crane is an open hearth charging crane where temperatures reach as high as 145 F. Dust and fumes were annoyances, but not to any considerable degree.

Figure 16 represents one of the hotter operations, in the manufacturing of steel. This is a ladle crane on the pit side of the open hearth. Temperatures of 150 to 160 F have been reached in this operation due to the radiant heat, both from the ladle and also from the newly poured ingots. Fumes can be a nuisance in this operation to the crane operator, depending upon the type of coating used on the inside of the molds. Tar and pitch,

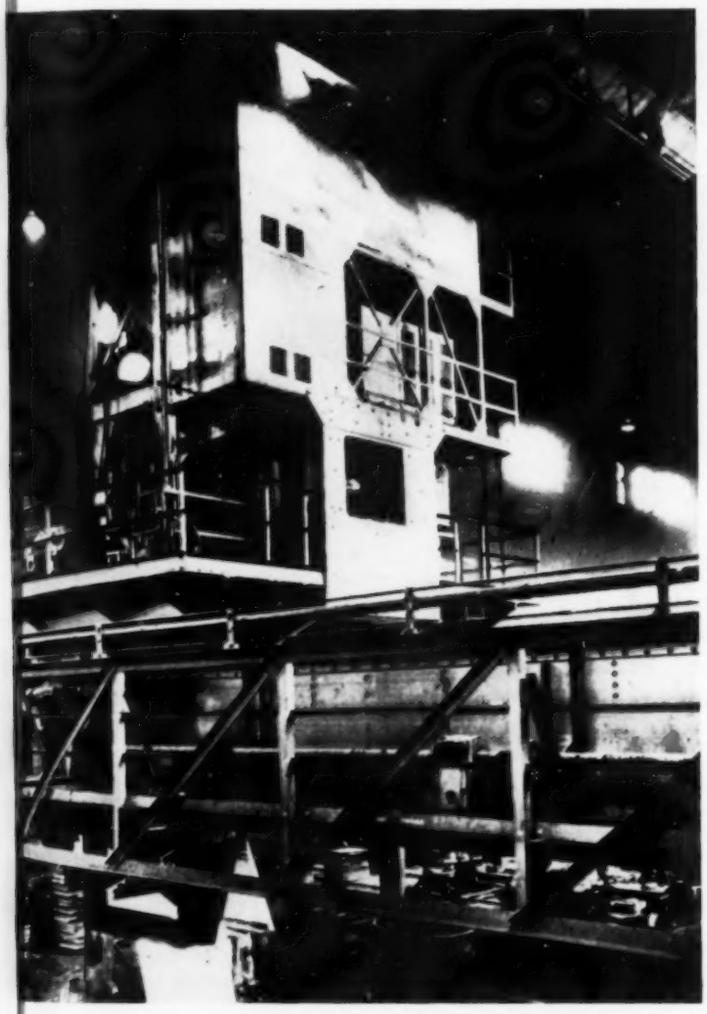


Figure 18 — The temperature data given in Figure 1 was taken on this soaking pit crane.

for example, when burning give off fumes and smoke, which have been sufficiently annoying to cause grievance complaints. Note that the air conditioning unit is directly over the cab, reducing ductwork to a minimum, which is recommended in these hotter atmospheres.

Figure 17 is a soaking pit operation where temperatures of 160 to 170 F are usual. Sulphur dioxide, some hydrogen cyanide are found in the atmospheres, and it is desirable to remove these irritants. Notice again the air conditioning unit is installed directly over the cab.

Figure 18 is a modern soaking pit crane, the cab being designed for air conditioning prior to fabrication. It was on this particular installation that the temperature tests indicated in Figure 1 were recorded, on a 24 hour a day basis. The bulb of the thermostat recording ambient temperatures was placed directly in front of the crane operator on the exterior of the cab. The bulb of the recording thermometer, which recorded the inside cab temperatures, was placed approximately two feet above the glass window in the floor of the cab, so that the effect of radiant heat on inside cab temperatures could be determined. The installation of air conditioning as indicated on Figure 1 reduced the temperatures to comfortable conditions and removed the products of combustion from the gases used in firing the pits.

In view of the tests and information discussed herein, it is quite apparent that crane cab air conditioning units which combine adequate, ample refrigeration with an effective method for reduction or elimination of dust and dirt, fumes and gases, provide a highly satisfactory and economical method for increasing efficiency and improving working conditions. Its use will minimize serious safety hazards while, at the same time, improving industrial relations.

DISCUSSION

PRESENTED BY

BARTLETT R. SMALL, Staff Engineer, Central Mechanical Engineering Department, Aluminum Co. of America, Pittsburgh, Pa.

GORDON B. FORBES, Mechanical Superintendent, Magna Works, American Smelting and Refining Co., Garfield, Utah

CHARLES J. ENLIND, Engineer of the Working Conditions Committee, Carnegie-Illinois Steel Corp., Pittsburgh, Pa.

THOMAS ARTEME, Air Conditioning and Ventilation Engineer, Ford Motor Co., Rouge Plant, Dearborn, Mich.

W. A. LINTERN, President, Lintern Corp., Berea, Ohio

RICHARD D. DARRAH, Dravo Corp., Pittsburgh, Pa.

Bartlett R. Small: Mr. Darrah may be possibly a little too conscientious to discuss two delicate points. When crane cab cooling is contemplated two questions always arise; namely, is not partial or relief cooling all we need, and second, is there not some cheaper and more simple way?

As to relief cooling, when an operator works in an open cab at 120 to 150 F, one would think a cooling unit that provides 100 F would meet every requirement. Or better yet, perfect satisfaction should ensue with a cab cooled to outdoor temperatures which admittedly is adequate for health and efficiency. Why does he need deluxe conditions of 80 to 85 F or that which is typical of air conditioned offices?

We have tried relief cooling in order to secure economies in power consumption and first costs and spent one summer trying to sell the plant force on this theory.

But it failed because, as we see it, the operator experiences more heat than a dry bulb thermometer in the cab indicates. He encounters heat radiated from molten metal or high temperature furnace shells, plus the reradiation from hot structural steel, roof decking and side walls, all adding up to a mean radiant temperature 5 to 15 F in excess of the indicated cab dry bulb temperature.

As another consideration, heat discomfort can be withstood by people to a reasonable extent when there are no available means to correct it, but just as soon as an air cooling unit is installed one immediately seems to demand first quality performance. Any one of us is pleasantly aware when his body temperature control mechanism is satisfied, a condition most easily attained in an ambient temperature of about 80 F dry bulb where periods of occupancy exceed 30 minutes.

In urging one to avoid this particular fallacy of partial cooling, some of us will remember when restaurants and stores tried to get along with relief cooling during the '30's. As a result, complaints and legal actions drove many air conditioning contractors nearly out of business. A relief cooling installation with undersized equipment that fails to produce the satisfaction of an 80 to 85 F dry bulb can only result in discredit to the vendor, the plant engineer and the management. It is far better to receive credit for good intentions and gain the good will of crane operators by following the recommendations of experienced cab cooling unit manufacturers.

Secondly, many of us present have unsuccessfully tried to find a cheaper method than refrigeration to obtain heat relief for the crane operator. Our plants have tried out various conceptions of fresh air arrangements, air curtains, filters and fans, and mancoolers to meet their own particular weather and air conditions. We can remove a horizontal strip of horizontal siding, if the cab is over at the side wall, to bring in fresh air, but the difficulty is getting a sufficiently close air connection to bridge the gap occupied by the building column and the crane column. As other deterrents, whenever the prevailing wind direction changes our wall inlet becomes an exhaust and the outgoing hot air is picked up by the fan, and this siding must be replaced in winter.

A trailing intake is often used to draw in cool air from down near the floor, provided the equipment below does not conflict. This helps and does a fair job in borderline cases, enough to warrant the installation, in some locations.

We tried a vertical air curtain, blowing 3000 cfm upward at 40 miles an hour from a slot around the perimeter of the cab floor. With the crane stationary it worked very well and isolated the operator from the fumes and dusts, but as soon as the crane travelled down the room, the air curtain could not be maintained.

When no cooling is needed, a bag filter and activated carbon arrangement cleans and decontaminates the air the author points out. But when the static pressure he mentions is required, the fan does more work and raises the temperature of the supply air 4 or 5 F, so that set-up is not too good unless an air conditioning unit is used.

Finally, we must remember that any cab enclosure makes a hot box for the operator, brings the hot surfaces close to him, and raises the mean radiant temperature. Unless only dust and fume relief is desired, and the maximum hot weather ambient is low, say 100 F, I believe a cab should never be enclosed unless refrigeration is provided.

For one proof of this, all of us can remember when a cab cooling unit is out of commission and we go up into the cab, we immediately notice the aggravated heat condition inside. These improvisions for cheaper cooling systems are stop gaps and they fail to be a permanent solution. In our experience it was found the wiser course to buy cab air conditioners and the majority of these have rounded cabs and seated operators similar to the illustration in the paper.

Gordon B. Forbes: I come from an industry that is very much unrelated to your industry as I am employed by the American Smelting and Refining Co. in the Garfield, Utah plant, which is considered the largest copper smelter in the world.

In the copper smelting industry we have a very difficult problem in our converter aisles with our crane operations. In the converter aisle we have eight 13 x 30 ft converters, each of which have 46 tuyeres through which air is forced to oxidize the charge. The charge is known as copper matte, which is composed of about 40 per cent copper, probably 40 per cent sulphur, and the balance iron, which is fluxed with silica, and in so doing the atmosphere is contaminated with silica dust. Also when oxidizing the sulphur, SO_2 is formed which contaminates the atmosphere especially when the converter turns out of stack to skim slag, or to take another charge of matte.

In the reverberatory operation adjacent to the converter aisle, in which the copper matte is formed, hot calcines at temperatures up to 1200 F are charged into reverberators from charge cars. This calcine is made up of particles, 80 per cent of which will pass a 300 mesh screen.

In charging the reverberator with this hot fine product, we naturally have heat columns rising from the car carrying these very fine particles with it, which are in turn deposited on roof trusses, beams, etc., throughout the building. Our building is very similar to an open hearth structure, that is, quite open and when we have severe windstorms the dust in the converter aisle is terrific.

Back in 1925, we began to experiment with air conditioning of a sort, appreciating what the crane operator had to contend with, radiant heat, dust and SO_2 fume. We have radiant heat similar to that encountered in soaking pit crane service, although temperature is probably not quite as high. Our cranes are handling 600 to 800 ladles of hot metal at 2100 F throughout the 24 hours of each day.

In 1935, we tried mechanical refrigeration and we went through the process of learning the hard way how to solve this problem. A local refrigeration concern was contacted concerning the problem, and to them it was a very simple job. The ¾-hp unit installed wore out in the first three weeks of operation. We then installed 2-hp units, the largest air cooled units available at that time, and we are fortunate if we go through a season without failures. We have four standby units for four units in service.

Another difficulty we encountered is that I do not think you can go too far in the protection of all tubing carrying gases. I would insert all tubing in a sponge

rubber tube, as vibration is very severe on tubing since it causes it to break and rubs holes through it wherever it has contact with any metal. It should be securely fastened as well. I need not mention what vibration is to those who are familiar with what it can do. During the war we had considerable trouble with loss of gas through holes being rubbed in tubing and every time this happened it was necessary to get a directive from Washington in order to obtain a 25 pound cylinder of freon gas.

We have found that the viscous type filter is not adaptable to very heavy dust burdens with a crane that has to be in continuous service 24 hours a day as they plug up and it then is necessary to take the crane out of service to change filters.

With this in mind we developed a filter element which is the result of 12 years effort. With SO_2 gas we found it necessary to use woolen bags as the SO_2 attacked cotton. We also found that being very generous with activated carbon filter area gave us very good service and requires very little effort on the part of the operator or the service people to take care of it. In other words, in a very few minutes the activated carbon containers can be changed, as on that part of the cabinet the door swings open and the units can be withdrawn and new units slipped in. The shape of the units and the arrangement was designed in order to get maximum area. The same ease of servicing applies to the bags.

I have seen dust burdens stop air flow through these bags and with this arrangement it is a simple matter for the operator to shut off the fan, shake the bags a few times with a lever, and the dust drops off. It settles in a layer on the bottom of unit, and lies there until cleaned away. He waits a moment or two then starts fan, and is on his way again. This it will be seen aids greatly in giving good continuous crane service.

Due to the presence of the SO_2 gas we had to obtain a perfect seal around all units. It will be noted that the carbon containers fit into a felt labyrinth seal, with which there is very little chance of SO_2 short circuiting activated carbon which absorbs it. Mr. Darrah's paper has been very well presented and I believe that manufacturers are now offering a unit for crane cab air conditioning that will give very good service, and I think that anyone considering the installation of crane cab air conditioning should survey very thoroughly the dust and fume concentrations. It really can be the difference between a successful operation or one with a great deal of trouble.

C. J. Enlind: The following remarks will be confined to our experience with crane cab cooling units and some of the difficulties encountered. Suggestions will also be made in regard to some of the features desired in this kind of equipment when viewed from the standpoint of operation and maintenance. A review of our experience with crane cab coolers shows that we have been using this kind of equipment since 1936. Most of this experience has naturally been with water cooled units.

In many cases, maintenance expense has been excessive and there have been many interruptions to service. Maintenance reports show that the principal repair and maintenance problems on our present units include the following:

1. Burned out motors due to overheating and overloading.
2. Failure of electrical control contacts, not heavy enough for service required.
3. Filters require frequent cleaning. A larger face area would correct this objection in most cases.
4. Design. Many parts are not rugged enough to withstand the severe operating conditions on these heavy duty cranes. We have had to rebuild most of the supporting frames and drives on the present machines.
5. Maintenance difficulties. The repair crews advise that the newer units are too compact in design to permit easy access for making repairs. A few inches would correct this.

In addition to the above, we find that considerable attention should be given to the design of the crane cab if it is to be equipped with a cooling unit.

Such cabs should be no larger than necessary to house the crane controls and the operator. Good vision is of vital importance and windows such as thermopane or equal should be designed for opening only for cleaning or in case of emergency. Where possible, the floors should have 5 to 6 in. of insulation and walls and ceilings about 4 in. of insulation. In most cases it is advisable to install a steel heat deflector under the cab floor. A cab such as the above can be made to withstand our most severe operating conditions.

Referring next to temperatures, it is suggested that the cab temperature be designed for 80 F and 50 per cent relative humidity. In many cases, part of the crane working zone is very hot and the operator will naturally enter and leave the cab at a relatively cool point on the runway. To avoid body shock, the operator should be advised to operate the cooling unit so that he will not normally be subjected to a temperature difference greater than 20 F when entering or leaving the cab. A thermometer should be installed at the cab to show both inside and outside temperatures.

The subject of filters is also important in both operation and maintenance. Mr. Darrah has shown a bag type filter supplemented by activated carbon pans and a cleanable wire mesh filter. This equipment will remove most of the more common objectionable fumes and dust found in steel mill operation.

Before selecting air conditioning equipment for use in any zone where there may be excessive fumes or dust concentrations, it is suggested that atmospheric conditions be checked with instruments. Results will show whether or not the concentrations are such that a specific filter medium will be required.

In some cases, where dust and fume concentrations are heavy enough to affect visibility in a working area, it may be advisable to install equipment that will exhaust the excessive dust and fumes at the source. By doing this, we provide safer operation and usually simplify our crane cab air conditioning problem.

In summarizing, it is suggested that considerable attention be given to maintenance when designing future crane cab air conditioning units. Before purchasing these units, it is suggested that a thorough check be made of operating conditions in the working zone so that suitable equipment will be provided and maintenance be kept to a minimum.

Thomas K. Arteme: We have various types of cranes, and I think this is one of the main reasons that we are able to make such a quick change-over from an old

model to a new one. In order to keep our crane operators comfortable and efficient, with the cooperation of our industrial health and safety department, we have designed and installed an appropriate system of ventilation for each crane cab, from ordinary ventilation to complete air conditioning systems.

As some of our cranes were installed long before we ever thought about air conditioning crane cabs, we had to redesign the cabs to conform with the requirements and specifications of crane cab air conditioning unit manufacturers.

In some cases we had to remove and relocate resistors, electric panels, and so forth, to reduce the heat load in the operator's cab. It is obvious that this procedure was very tedious and very costly. However, the job is done without many interruptions to crane operations, bearing in mind that our cranes in the steel mills are operating 24 hours a day and seven days a week, with two operators on each eight-hour shift, without very much time to spare.

William Allan Lintern: The only thing that I might add to Mr. Darrah's talk, which was very well given and covered the situation about as well as it could be done, is that we do have a new development in which we eliminate the air ducts between the unit and the cab. In this new development the condenser unit is located at any convenient place on the crane and the evaporator or cooling blast coil is placed in the cab. The two units are connected with refrigerant lines properly secured and protected against line breakage.

The advantages resulting from this are reduced engineering costs; elimination of expensive, efficiency-reducing air ducts; higher cooling efficiency in the cab; greater flexibility in location of all equipment; lengthened life of operating equipment because of protection from excess radiant heat and greater accessibility for service; location of unit on existing cranes without moving any other equipment which reduces the total cost of installation.

The savings in elimination of air ducts range from $1000 to $2500 per installation, depending on the type of installation.

We have not changed our condenser unit, which has been in operation for the past three or four years without too much maintenance trouble. We provide a separate air filter unit in the cab, which includes the screen type and activated carbon filters together with the electric heating for winter use.

Richard D. Darrah: The splitting of a compressor and condensing or cooling section into two separate units connected by refrigerant lines is quite common practice where vibration, shock and impact are not factors of any great degree in the design of a system. Recognizing the fact that all cranes are subject to vibration, violent shocks and impacts, experiences have indicated that these conditions are transmitted through the refrigerant lines, and at connections or points of support, crystalization of copper pipe and tubing takes place, which results in cracks and breaks, thus permitting the refrigerant charge to escape to the atmosphere, causing complete shutdown of the equipment.

In the first place it is necessary to support the refrigerant lines for any length of run of pipe, especially if elbows are required. It is at this point of support where such failures may be anticipated. Another factor which must be considered is that the installation of such refrigerant lines should be made by a competent mechanic familiar with silver soldering and also the various methods of dehydrating the moisture from within the refrigerant piping which connects the two sections of the air conditioning equipment. Naturally, if this moisture is not sufficiently removed, it will combine with the refrigerant to form a mild acid which will attack portions of the equipment, sludging up the needlepoint of the thermal expansion valve, and if a sufficiently large amount of moisture is present in the lines, this moisture will actually freeze at the expansion valve opening.

Consequently, the question arises with such an installation, is there not a joint responsibility between the manufacturer of the crane cab air conditioning equipment and also the user, who would be the party normally to install the connecting refrigerating piping. We prefer, and it has been our experience with our users that they also prefer, that the responsibility for the satisfactory performance in operation of the air conditioning equipment is placed solely in the hands of the manufacturer of that equipment, thus eliminating a considerable amount of controversial questions and problems, should there be dissatisfaction on the part of the user of the performance and operation of such equipment.

Considering this type of installation from the overall picture, is there any saving, particularly in such installation as a split system mentioned by Mr. Lintern? In the event the cooling section is placed within the cab, will not the cab necessarily have to be larger than might otherwise be required just to compensate for the floor space and wall surfaces occupied by this cooling section? In the second place, vibration eliminators in refrigerant lines are quite expensive, since a total of four would be required, one at each end of the liquid line and one at each end of the suction line, plus the cost of labor for silver brazing the joints, plus the cost of tubing or pipe.

Considering the fact that a crane cab air conditioning unit for extreme conditions weighs in excess of a ton, the cost of rigging two sections weighing approximately 1000 lb each will cost more than rigging one complete self contained unit weighing a ton, since twice the amount of time would be required.

It is my particular belief that the savings inferred by using a split unit would not be considerable, and in fact in many cases the cost of a double unit could be as great, if not greater than an installation using a self-contained unit with short duct sections. Refrigerant lines cannot be exposed to the high temperatures encountered over soaking pits or in such high temperatures found in plants where crane cab air conditioning is required without being quite well insulated. If these lines are not heavily insulated, the temperature of the refrigerant will rise with resulting high operating pressures which could be sufficiently high to cause seal leakage at the compressor, and possibly leaks at piping joints. Pressures as high as 350 to 450 psi have been developed under such conditions. Considering the fact that the normal operating pressure of the compressor is approximately 225 to 250 psi, it can be seen that these elevated pressures go considerably beyond the allowable working pressures.

1949 AISE Spring Conference

PROGRAM

MONDAY, MAY 2, 1949

9:00 a.m. — Registration — Second Floor Foyer

9:15 a.m. — Technical Meeting — Calvert Room

Blooming Mill Operations at Keystone Steel and Wire Co.
William Herman, Superintendent of Rolling Mills
Keystone Steel and Wire Co.
Peoria, Ill.

New Rod Mill for Rolling Stainless Steels at Rustless
Edward T. Peterson, Lewis W. King and Edward C. Peterson
Birdsboro Steel Foundry and Machine Co.
Birdsboro, Pa.

Electrical Equipment for a Modern Rod Mill
F. R. Burt and R. W. Moore, Metal Working Section
Westinghouse Electric Corp.
East Pittsburgh, Pa.

9:15 a.m. — Technical Meeting — Founder's Room

Electric Equipment for High Speed 2-Stand Temper Mills
Roscoe E. Marrs, Application Engineer
Steel Mill Division, General Electric Co.
Schenectady, N. Y.

Power Supply and Electrical Features of a 68 in. Hot Strip Mill
F. O. Schnure, Electrical Superintendent
Bethlehem Steel Co.
Sparrows Point, Md.

Main Drive Motors for a 68 in. Hot Strip Mill
H. W. Bartling, Steel Mill Section
Allis-Chalmers Manufacturing Co.
Milwaukee, Wis.

1:00 p.m. — Buses leave Lord Baltimore Hotel for Inspection trip through plant of Rustless Iron and Steel division of Armco Steel Corp.

7:00 p.m. — Dinner — Calvert Room

Speaker: Stewart J. Cort, Vice President, Bethlehem Steel Co.

TUESDAY, MAY 3, 1949

9:00 a.m. — Technical Meeting — Calvert Room

Roll Design of Small Shapes
William H. Mohler, Superintendent Roll Turning Department
Carnegie-Illinois Steel Corp.
McDonald, Ohio

Budgeting Blooming Mill Maintenance
J. Harry Mayer, Assistant Superintendent
Blooming Mills Department
Jones & Laughlin Steel Corp.
Pittsburgh, Pa.

9:00 a.m. — Technical Meeting — Founder's Room

Design and Performance of Modern Large Rotary Furnaces
Andrew F. Kritscher, Development Engineer
National Tube Co.
Pittsburgh, Pa.

New Power for Sparrows Point
J. M. Spencer, Assistant Fuel Engineer
Bethlehem Steel Co.
Sparrows Point, Md.

12:30 p.m. — Buses leave Lord Baltimore Hotel for Inspection Trip through Sparrows Point Plant of Bethlehem Steel Co.

HOTEL RESERVATIONS SHOULD BE MADE DIRECT TO THE LORD BALTIMORE HOTEL, BALTIMORE 3, MARYLAND STATING THAT THEY ARE FOR THE AISE SPRING CONFERENCE. RESERVATIONS SHOULD BE MADE AS SOON AS POSSIBLE IN ORDER TO OBTAIN REQUIRED ACCOMMODATIONS.

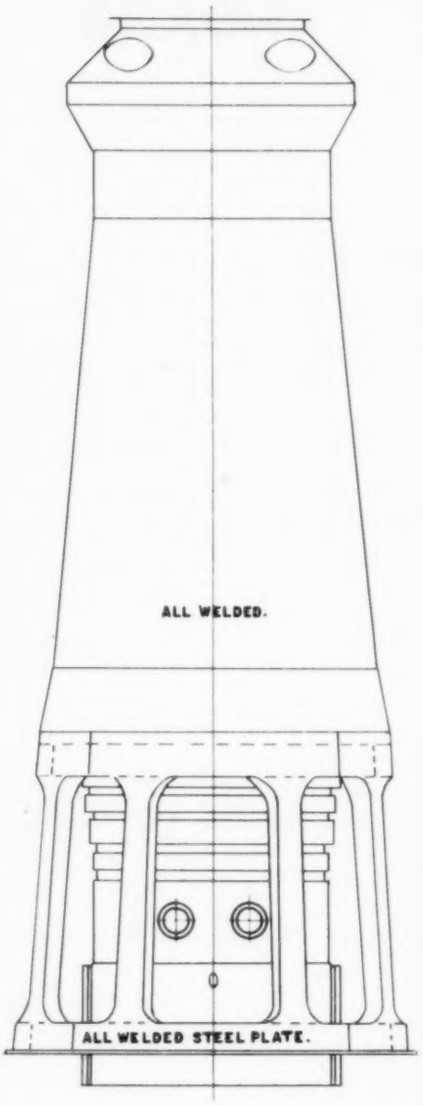
EARTHQUAKE-PROOF BLAST FURNACE STRUCTURE

▲ The steel plant of the Compania de Acero del Pacifico, at present under construction at the Bay of Vincente, 5 miles from Concepcion, Chile, is in a location subject to severe earthquakes. How to construct the blast furnace to withstand seismic forces was one of the most important design problems, as the Chilean earthquake experts, Professor R. Flores and Senor E. Arze were not satisfied with the conventional blast furnace mantel support commonly used in the United States. After considerable study of this problem Mr. F. E. Kling, chief engineer for H. A. Brassert & Co. on this project, designed the all-welded mantel support shown by the accompanying drawing and in the photograph recently taken in the William B. Pollock Co. shop in Youngstown, Ohio.

This design is a radical departure from the usual American practice. The base, columns and mantel are made up of rectangular, hollow box-girder sections fabricated by welding from 1¼ in. steel plates. The design is calculated to give maximum stiffness to the whole structure so that it will adequately resist the bending, twisting and buckling forces likely to accompany an earthquake. The junctions of the base and mantel with the columns are flared out so as to transmit forces between adjoining parts without any excessive local concentration of stresses. The base, columns and mantel after being welded together form a rigid monolythic structure.

In addition to being earthquake-proof, the new design is considerably cheaper to fabricate and erect, containing less than half as much steel. For the 680 metric ton furnace designed for Chile the weight of the furnace compares with one of conventional design as follows:

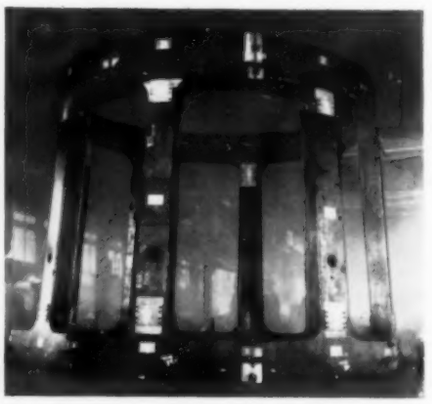
The new Chilean blast furnace is rated at 680 metric tons.



	Conventional design	New design	Saving
Weight...	528,000 lb	242,000 lb	286,000 lb

For a 12-tuyere, 20-foot hearth furnace, the conventional design calls for 12 columns while the new welded box girder design permits the use of only 8 spaced alternately 40 and 50 degrees apart. This affords increased working space around the hearth and results in a much more desirable and practicable arrangement, since it eliminates the necessity of having tuyeres directly above the iron and cinder notches.

Only eight box girder columns were used in the furnace design. The use of this section gives unusual strength against twisting forces.



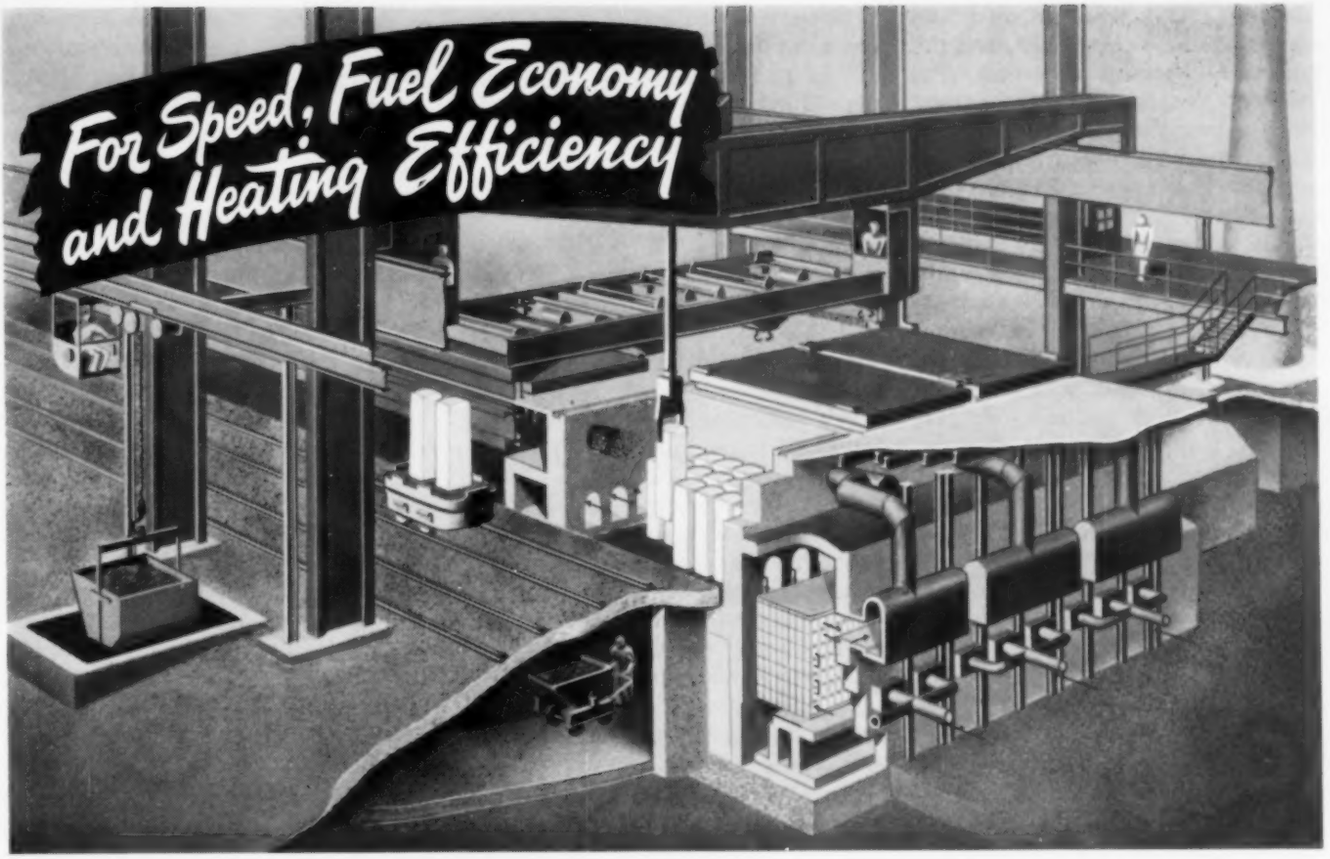
PROGRESS MADE IN SYNTHETIC FUELS PLANTS

▲ Federal loans to industry for the construction of the pioneer American commercial plants producing oil and gasoline from coal and oil shale were strongly recommended on February 2, 1949 by Secretary of the Interior J. A. Krug in his 1948 annual report to Congress on research and development progress of the Bureau of Mines in synthetic liquid fuels.

The Bureau of Mines has through research and development in the Bureau's laboratories and demonstration plants made substantial progress in the past year toward providing a pattern of knowledge that ultimately will free Americans from further anxiety about shortages of gasoline for their cars or heating oil for their homes. Highlights of the annual report follow:

At Louisiana, Mo., two coal to oil demonstration plants, the first units larger than pilot plants in the United States, were under construction on the site of a wartime synthetic ammonia works.

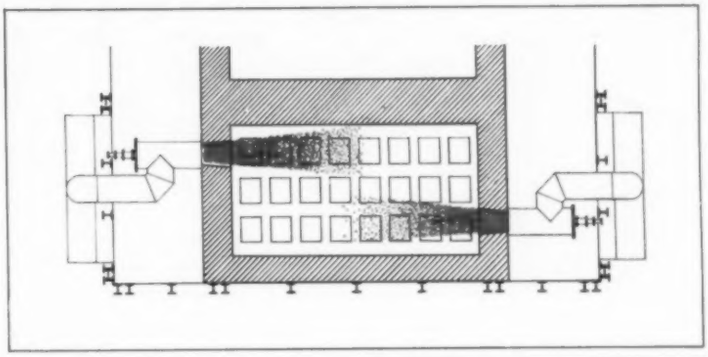
The first, a 200 to 300-barrel-per-day coal hydrogenation demonstration plant, erected under contract with Bechtel Corp. of California, was essentially complete and ready for operation. Although some finishing work remained to be done in January, test runs were under way in the distillation, oxygen, and coal prepara-

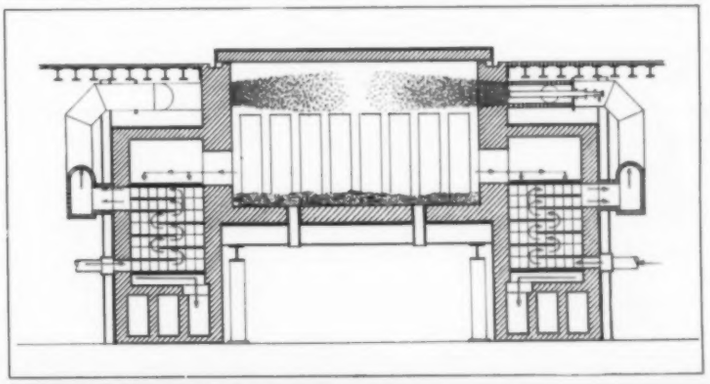


RUST CONTINUOUS-FIRED SOAKING PITS

Two-way top fired ▲ Completely automatic ▲ Recuperative type ▲ All fuels

THESE ULTRA MODERN SOAKING PITS provide increased efficiency, increased economy and greater charging capacity per sq. ft. of area. By diagonal two-way firing the heat is distributed uniformly throughout the pit and on cut backs both ends of the pit remain in balance thus ingots soak out evenly. Absence of impingement increases life of refractory walls and covers. Design permits construction in batteries of two or more holes.





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PIONEERS IN FURNACE DESIGN

PITTSBURGH, PENNSYLVANIA

tion units. An operating crew had been assembled and trained, and the plant was scheduled to be broken in with coal tar oils within the next month or two. Chemically, crude petroleum contains about twice as much hydrogen as does coal. Thus to convert coal to finished gasoline by this process, hydrogen is added to the coal catalytically under the proper conditions of temperature and pressure.

The second plant, a 100-barrel-per-day gas synthesis demonstration plant, was being built under a design and construction contract let last March to Koppers Co., Inc., of Pittsburgh, Pa. A building had been erected and most of the equipment was in place for the coal gasification unit, scheduled for completion in April, 1949. With synthesis units to be installed later, this plant was estimated to be about 20 per cent completed. It will gasify pulverized coal with oxygen and superheated steam, purify the gas, and convert it to liquid fuels by a modified Fischer-Tropsch process.

With the aid of German consultants having years of experience, engineering studies and cost estimates for coal hydrogenation plants of commercial size were made by Bureau of Mines engineers. These figures, in turn, were used to arrive at synthetic gasoline prices. In a 30,000-barrel-per-day hydrogenation plant, gasoline costs would range from 12 to 15 cents a gallon if credit is taken for by-product liquefied petroleum gas at 8 cents a gallon. If credit also is taken for phenols at 10 cents a pound, the gasoline costs would be reduced by about 4 cents a gallon or virtually to competitive levels.

At the request of the Department of the Interior, the Army Corps of Engineers was conducting a nationwide survey to determine general areas where requirements for one or more synthetic fuel plants can be met. For use in this survey, the Bureau assembled and provided data on the basic requirements of cost, construction materials, raw materials, water, and construction and operating manpower for commercial plants of different sizes and types.

At Bruceton, Pa., radical new process improvements under development in the Bureau's coal to oil laboratories and pilot plants offered promise of advancing the day when the United States could shift a part of the growing burden of oil and gasoline demand to its immense coal reserves.

These research activities were centered in the past year on reducing synthetic fuel costs by (1) fundamental improvements in the gas synthesis process, and (2) a basically new approach to the direct hydrogenation process. Notable progress was made on item 1, for two new-type converters were developed to the point where they could be incorporated in the demonstration plant at Louisiana, Mo. Results on item 2 were very encouraging, but the engineering problems are difficult and much pilot plant development work remained to be done.

At Pittsburgh, Pa., powdered coal gasification tests were made in a vortex combustor, a unique device in that the heat evolved per unit of space is about 100 times that of most other combustion chambers. Results again were deemed encouraging enough to warrant further study.

At Gorgas, Ala., the problem of producing cheaply the carbon monoxide and hydrogen required in synthetic fuels manufacture was being attacked from another salient. The Alabama Power Co. and the Bureau of Mines jointly undertook site preparations for their second field-scale experiment in the gasification of coal underground. Gases produced by burning unmined coal offer not only raw materials for synthetic fuels manufacture but a potential source of fuel for electric power generation. In addition, underground gasification holds promise as a method for using coal veins now difficult or uneconomic to mine. Site construction will be completed at Gorgas in February, and the coal bed will be fired shortly thereafter.

At Morgantown, W. Va., in the Bureau's synthesis gas production laboratories further research was in progress on gasification—key to the entire problem of producing competitive liquid fuels from coal. There, some of the procedures for the field-scale experiment in underground gasification at Gorgas were worked out in a small model simulating a bed of coal in place underground. There, too, other gasification methods were being investigated in the first pilot plants placed in operation in this country.

Operations were continued in a small unit that each hour gasifies 20 to 30 pounds of pulverized coal entrained in superheated steam containing oxygen, and the initial runs were made in a new and larger unit gasifying 200 to 300 lb of pulverized coal an hour. Steam was heated to unprecedented temperatures approximating 3,600 F during several months of successful operations in experimental pebble stoves. Ultra-superheated steam reduces the volume of oxygen required.

A new and improved method was developed for feeding pulverized coal into gas generators, and new methods also were developed and cost estimates prepared for purifying synthesis gas.

Near Rifle, Colo., in the Bureau's experimental mines on the Naval oil-shale reserves, striking advances were made in 1948 toward developing low-cost methods and equipment for mining the oil-rich shale formations of Colorado, Utah, and Wyoming.

Underground operations were carried on in two sets of workings, the small selective mine, which supplies the Bureau's nearby demonstration plant with oil shale of any desired grade; and the underground quarry, a cliffside cavern opened to permit investigation of commercial-scale mining problems.

In the selective mine, 13,400 tons of oil shale were mined and delivered to the demonstration plant. An additional 1,830 tons were mined and shipped to oil companies for retorting or oil extraction texts. The larger operation mined and stockpiled 47,000 tons in the course of experimental work.

In this quarry-like operation, unique mining methods and equipment were developed to assure low-cost production. In a recent 20-day test run under actual commercial operating conditions, a total of 81 tons was produced per man day underground as compared to an average of 5½ tons per man in deep coal mines. Direct mining costs were only 50 cents per ton of shale.

In the oil-shale demonstration plant, experimental operation of the N-T-U batch retorts was continued to obtain crude shale oil and to determine data useful in designing continuous units. Part of this oil was burned successfully as plant boiler fuel; part was used for refining studies by cooperating groups and the Bureau's experiment station at Laramie, Wyo.; and the remainder was stored for use as feed stock in a new experimental refinery at the plant. Distillation operations were begun in this virtually completed refinery unit, and cracking operations were to be undertaken as soon as possible.

Design and construction was completed and the initial test runs were made in a new continuous retort for extracting oil from shale. Although few operating data were yet available, preliminary runs indicated that this unit known as the gas-flow retort or some modification thereof may prove suitable for the economical recovery of oil from American shales.

At Laramie, Wyo., in the petroleum and oil-shale experiment station, laboratory studies were conducted on both retorting and refining processes.

Efficient use and conservation of heat being important factors in retort operation and design, determinations were made of the over-all heat required to retort some grades of Colorado oil shale and work was under way on additional grades. An experimental evaluation was made of the thermal solution process for extracting oil from shale. Rates at which the organic material in various oil shales is converted to oil at different temperatures also were determined.

Refining research confirmed that hydrogenation is the most feasible known method of producing high yields of easily treated, high-quality products from shale oil.

EXTENSOMETER INDICATES STRIP EXTENSION

By G. H. RENDEL

Research Laboratory

Carnegie-Illinois Steel Corporation

▲ Actual plant tests of a unique type of continuously indicating and recording extensometer for measuring the percentage of extension of strip steel during rolling in temper pass mills have demonstrated the utility and accuracy of the instrument. It was common practice prior to installation of the extensometer to measure strip extension by a hand operated gage, and such measurements could not be obtained satisfactorily at mill operating speeds in excess of approximately 200 fpm. Since installation of the extensometer, mill operators have abandoned the practice of measuring extension by manual methods and are relying entirely upon the instrument for all extension measurements, at operating speeds up to 2000 fpm.

The extensometer is designed to indicate and record the percentage of extension being effected on the temper pass mill, by measuring the entry and delivery speeds of the strip, and comparing the differential between the two speeds with the entering strip speed. The entry-delivery strip speed differential is obtained by a system consisting of two synchronous transmitters, one driven by the entry and the other driven from the delivery deflector roll. The synchronous transmitters are electrically connected to a synchronous differential receiver. The receiver drives a tachometer generator that generates a voltage proportional to the true differential speed. A second tachometer generator is driven by the entry deflector roll and generates a voltage proportional to the strip entry speed. These two voltages are applied to a self-balancing potentiometer which indicates the ratio of the two voltages. Since this ratio is proportional to the strip extension, the potentiometer is calibrated accordingly.

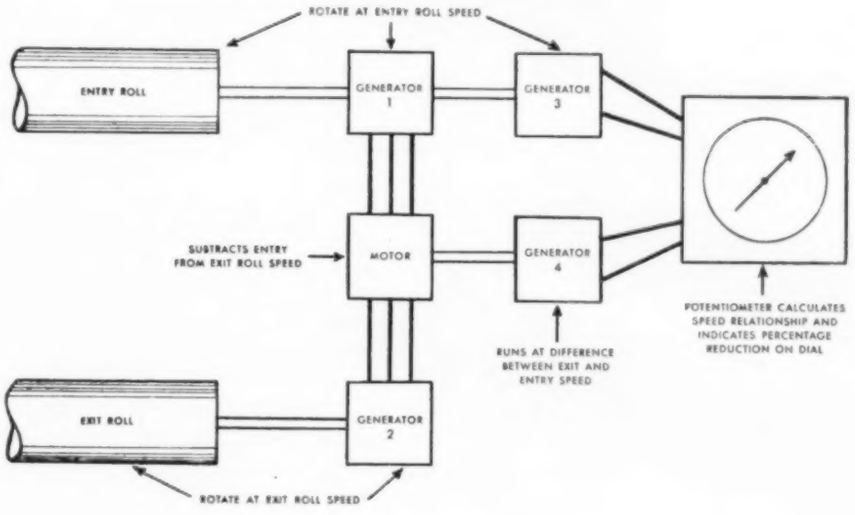
Figure 2 — The operator is watching the pointer on the circular dial of the extensometer, as he manipulates temper mill controls.

Figure 1 shows a schematic arrangement of the apparatus required for a typical temper pass mill extensometer installation.

The equipment is designed to operate with an accuracy of approximately 0.04 per cent over a range of approximately 8 to 100 per cent of normal strip operating speed, while measuring extension varying from 0.1 per cent to 8 per cent.

A number of tests were conducted to check the performance and accuracy of the instrument on an actual installation, including numerous tests in which the indicated extension was compared with that of measurements obtained from marked test coils. The test coils were scribed prior to temper rolling and the extension was determined by computing the increase in measured distance between the scribe marks after temper rolling. The results disclosed that approximately 60 per cent of the tests indicated the same amount of extension by both methods and that the maximum deviation between the extensometer indication and the measured extension was 0.1 per cent.

Figure 1 — How extensometer works



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Simply by Installing

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"The fusible swing-out plugs in the bus duct system were 60 ampere capacity. It was soon found that 60 ampere ordinary fuses would not handle the starting surges or other temporary overloads caused by the additional equipment on the circuit.

"Our Electrical Engineer suggested Fusetron dual-element fuses. The troublesome, needless blows were stopped immediately.

"The Fusetron fuses permitted all machines to be kept in operation without any change in the size of the fuse holders."

Ferguson Electric Construction Co.,
Buffalo, N. Y.
C. P. Wachtel, Vice President

Facts About FUSETRON Dual-Element FUSES

The fuse link element opens on short-circuit — the thermal cutout element protects on overloads — the result, a fuse with tremendous time-lag and much less electrical resistance.

They have the same degree of Underwriters' Laboratories approval for both motor-running and circuit protection as the most expensive devices made.

Made to the same dimensions as ordinary fuses — fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere, both 250 and 600 volt types. Also in plug types for 125 volt circuits.

Their cost is surprisingly low.

FUSETRON is a trade mark of the Bussmann Mfg. Co., Division of McGraw Electric Co.

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with their

10 Point Protection

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5. Protect motors against burnout from overloading.
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7. Give DOUBLE burnout protection to large motors — without extra cost.
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One needless shutdown — or one lost motor — or one destroyed switch or panel — may cost you far more than replacing every ordinary fuse with a FUSETRON Dual-Element fuse.

Don't risk such losses — protect yourself by installing a FUSETRON Dual-Element fuse in every set of fuse clips throughout the entire electrical system.

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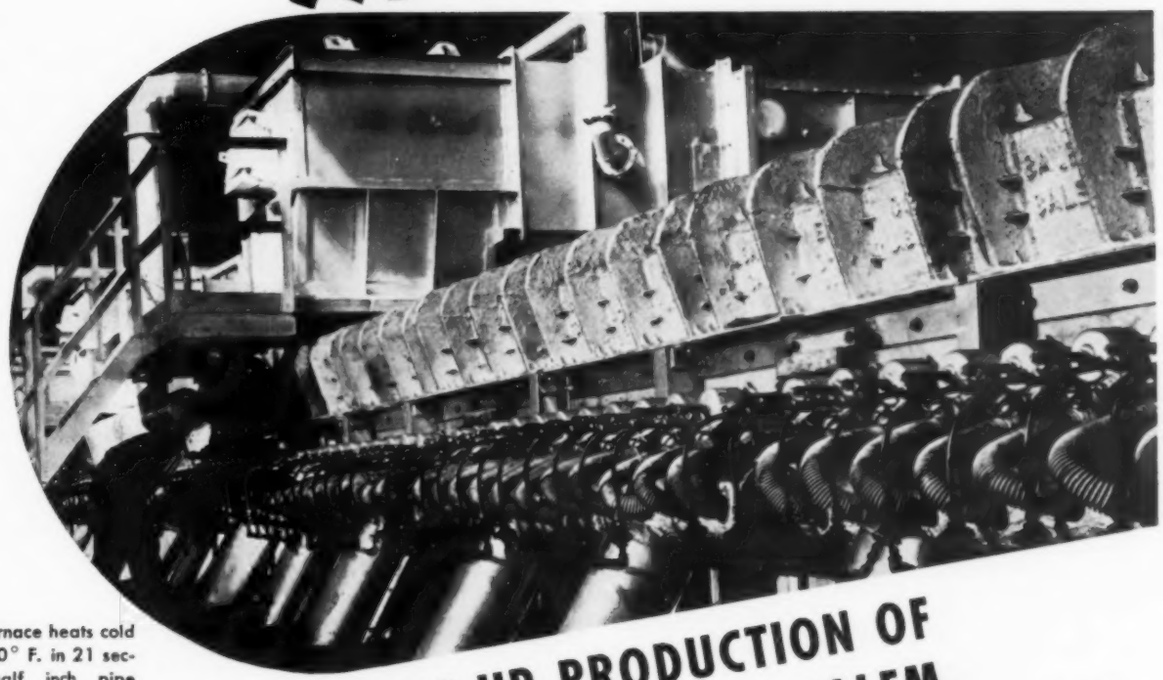

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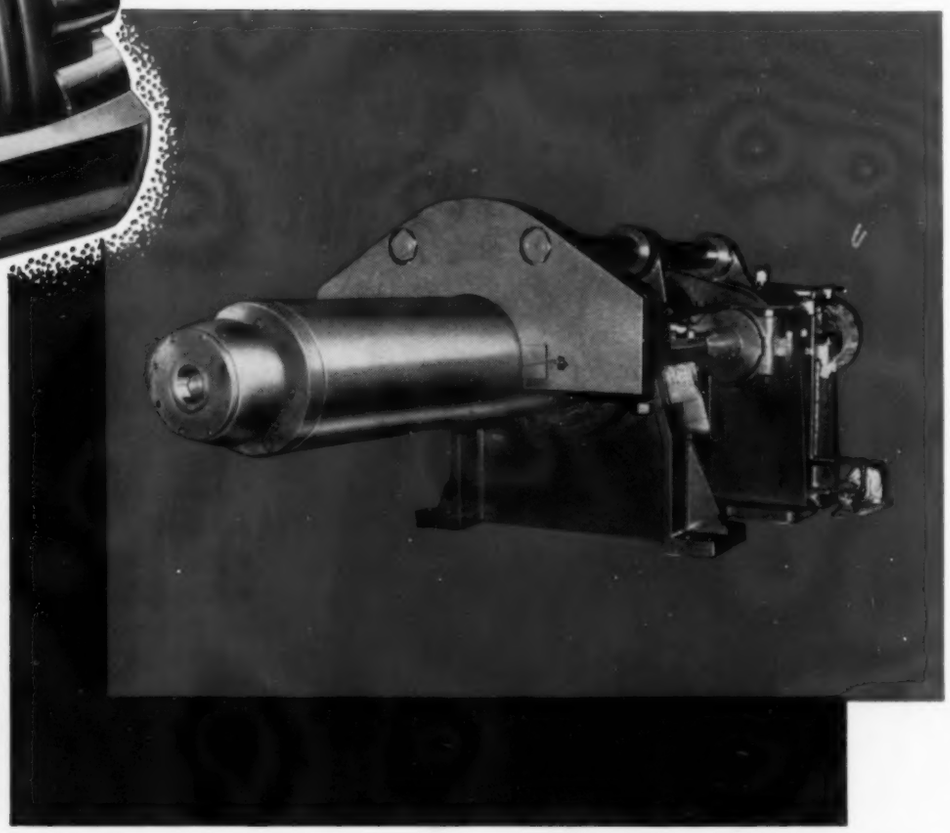


Industrial bearings engineered by SKF

Date-line Diary...

February 1

▲ Iron ore production increased 8 per cent over 1947 to a total of 101,350,000 gross tons from domestic mines and mills. Cost of shipments increased and the average value in 1948 was $3.95 a gross ton compared with $3.44 in 1947.

February 2

▲ Manufacturers sales in 1948 totaled $210,000,000,000 or a 12 per cent gain over 1947 according to the Department of Commerce. Manufacturers' inventories reached a new high at the end of the year of $31,700,000,000 for a slight rise over the previous year.

▲ Record budgets were submitted by the governors of three eastern states. New York's estimate is $936,000,000; Pennsylvania's estimate is $1,000,000,000; and Connecticut's estimate is $298,000,000.

February 3

▲ Scrap supplies are easier and one indication is the request for bids by the General Motors Corp. on their offerings.

▲ Esso Standard Oil Co. cut prices of heavy fuel oil from 15 to 20 cents a barrel thus starting a fourth round. Several other companies moved to meet these prices.

▲ The Nation's railroads and several of the unions asked the Presidential Fact Finding Board to take up again their wage hour dispute.

February 4

▲ For the four weeks ending January 29, rail freight loadings were 292,983 cars or 6.1 per cent under the like 1948 period.

▲ Kennecott Copper Corp. is planning to reopen their Utah mine which has been closed since last October 24. This is the largest copper mine in the United States.

▲ The Jones & Laughlin Steel Corp. postwar plant improvement program has been reestimated at $260,000,000 or $50,000,000 more than previous estimates.

▲ The American Railway Car Institute announced that domestic freight car deliveries during January were 8,913 compared with 9,967 in December. The backlog of cars totaled 96,214 compared with 119,711 one year ago.

▲ The Koppers Co., Inc. announced that sales in 1948 had passed the $200,000,000 mark for the first time in its peacetime history, well over the $163,000,000 in 1947.

February 5

▲ The Census Bureau reported that unemployment rose 700,000 in January to a total figure of 2,650,000.

▲ President Truman sent Congress a draft of his bill covering the anti-inflation program.

February 6

▲ The Sharon Steel Corp. is moving its Telopost Corp. plant from Akron to Farrell, Pa.

▲ During this past week Congress took action to continue the voluntary allocation of steel and other scarce material until September 30. Thirteen programs are in effect which cover 559,790 tons per month.

February 7

▲ The operating rate of the steel industry for the week beginning February 7, 1949 is scheduled to be 100.1 per cent of capacity or 1,845,400 tons compared with 1,860,100 tons one week ago.

▲ According to the Federal Reserve Board of San Francisco, ingot capacity in the West should expand about 700,000 to a total of 4,500,000 tons in 1950.

February 8

▲ General Motors Corp. declared a dividend for the quarter on their common stock of $1.25.

▲ The Standard Oil Co. of New Jersey states that crude oil imports from the middle east will be 40,000 bbl a day in the first quarter of 1949 compared with the 88,000 bbl in the fourth quarter of 1948.

▲ American Iron and Steel Institute announced that shipments of finished steel in 1948 set a new record of 65,973,138 net tons. December shipments totaled 6,056,282 tons.

February 9

▲ The Office of Defense Transportation warned the AAR that they will stop their efforts to obtain steel allocations for new freight cars unless the railroads place more orders for such cars.

▲ Scrap prices on the Pacific coast dropped from 9 to 20 per cent.

February 10

▲ American Iron and Steel Institute announced that the annual payroll for the iron and steel industry for 1948 is estimated at $2,234,461,000 for a new record. Average employment for the year was 635,600 and payments at the end of the year averaged $1.63 per hour.

▲ The Lukens Steel Co. reported a net profit of $1,316,315 for the first quarter of their 1949 fiscal year. This is equivalent to $4.14 a share compared with $1.50 a share the previous year.

▲ The F. W. Dodge Corp. reports that contract volume in January was $482,984,000 which is 31 per cent less than the previous month and 22 per cent less than January, 1948.

▲ Plans were announced by H. B. Stewart, Jr., president of the Akron, Canton and Youngstown Railroad to build a conveyor between Lorain and East Liverpool, Ohio for the purpose of hauling ore from and coal to the Lakes.

▲ The directors of the Acme Steel Co. have approved a proposal to split the company's stock on a two for one basis.

February 11

▲ The American Iron and Steel Institute announced that steel production in January was 8,172,236 net tons and for the first time exceeds 8,000,000 tons a month.

▲ Westinghouse Electric Corp. announced that delivery times and backlogs on electrical equipment particularly motors and transformers, have been appreciably cut and business is now shifting to a normal basis.

February 12

▲ Open hearth steel scrap dropped $2.00 a ton in Pittsburgh to a new figure of $37.00.

February 14

▲ The operating rate of steel companies having 94 per cent of the capacity of the industry will be 100.0 per cent of capacity for the week beginning February 14, 1949. This is equivalent to 1,843,500 tons of steel compared with 1,845,400 tons one week ago.

February 15

▲ Bureau of Labor Statistics reports the construction expenditures and number of workers employed in January on construction were unusually high.

February 16

▲ No. 7 blast furnace of the Tennessee Coal Iron and Railroad Co. is being taken out of production for relining and enlarging.

▲ American Iron and Steel Institute announced that more than 400 steel plants are making or finishing iron and steel in thirty states.

▲ Department of Commerce reported that shipments of German iron and steel scrap to the United States amounted to 150,270 tons in January or 42 per cent higher than the previous month.

February 17

▲ Phillip Murray, president of the C.I.O., informed the chairman of the House Banking and Currency committee that the steel industry had not expanded sufficiently and that several companies would be happy to avail themselves of government loans for expansion purposes.

▲ The Allegheny Ludlum Steel Corp. lowered base prices for silicon sheet and strip between $35.00 and $50.00 a ton.

▲ The Census Bureau reported that manganese and chrome ore imports in December were $2,700,000 compared with $1,400,000 in November.

February 18

▲ Jones & Laughlin Steel Corp. placed in operation today a new steam generating boiler house at its Pittsburgh Works with an estimated cost of $4,500,000. The boiler will deliver almost 1,000,000 lb of steam per hour.

▲ Youngstown Sheet and Tube Co. authorized a $2,000,000 improvement program. Work includes three new cranes costing $1,250,000 and a $700,000 coal washer.

▲ The Republic Steel Corp. and the Kaiser-Frazer Corp. signed a five year agreement for the continued operation of the Cleveland DPC furnace. Arrangement also provides for the construction of a 200-ton open hearth by Republic with Kaiser-Frazer paying the cost and purchasing the output.

February 21

▲ The operating rate of companies having 94 per cent of the steel capacity of the industry is scheduled to be 100.3 per cent of capacity for the week beginning February 21,1949. This is equivalent to 1,849,000 tons compared with 1,843,500 tons one week ago.

▲ The Bethlehem Steel Co. announced that it is increasing sizing extras on hot rolled strip from $8.00-$10.00 a ton and extras on pickling are increased from $2.00-$3.00 a ton in order to bring their price in line with other producers.

February 23

▲ According to preliminary estimates of the National Machine Tool Builders Association, new orders for machine tools in January were higher than any previous month since June, 1947.

▲ The Lone Star Steel Co. reduced its mill price for foundry iron from $75.00 to $50.50 a ton.

February 24

▲ American Iron and Steel Construction announced the estimated total bookings of fabricated structural steel for January were 125,834 tons compared with 169,553 tons the previous month, and 160,634 tons the same month of the previous year. Shipments declined to 147,659 tons.

▲ The Allegheny-Ludlum Steel Corp. announced that total sales for 1948 were $126,780,255 and net earnings were $6,833,384 or $5.05 per share of common stock after preferred dividends.

▲ The Follansbee Steel Corp. cut prices of some grades of silicon sheets by $23.00-$30.00 a ton.

▲ G. M. Humphrey, president of M. A. Hanna Co. estimates that $200,000,000 will be required to develop the Labrador-Quebec iron ore fields.

February 26

▲ General Motors Corp. cut prices on its passenger cars and trucks from $10.00 to $150.00 per unit. At the same time under the wage formula at that company, hourly wages are being reduced 2 cents an hour for the next three months because of the lowering of the Bureau of Labor Statistics consumer price index to 170.9 per cent.

February 28

▲ The Koppers Co. announced that the Missouri-Illinois Furnaces, Inc., a wholly owned subsidiary will be dissolved and made a plant in the coke and gas division.

▲ The House Judiciary Sub-committee approved a bill calling for a 16 month moratorium on new anti-trust prosecutions against "innocent and individual" freight absorption.

▲ The operating rate of steel companies having 94 per cent of the steel capacity of the industry is scheduled at 100.5 per cent of capacity for the week beginning February 28, 1949. This is equivalent to 1,852,700 tons compared with 1,849,000 tons one week ago.

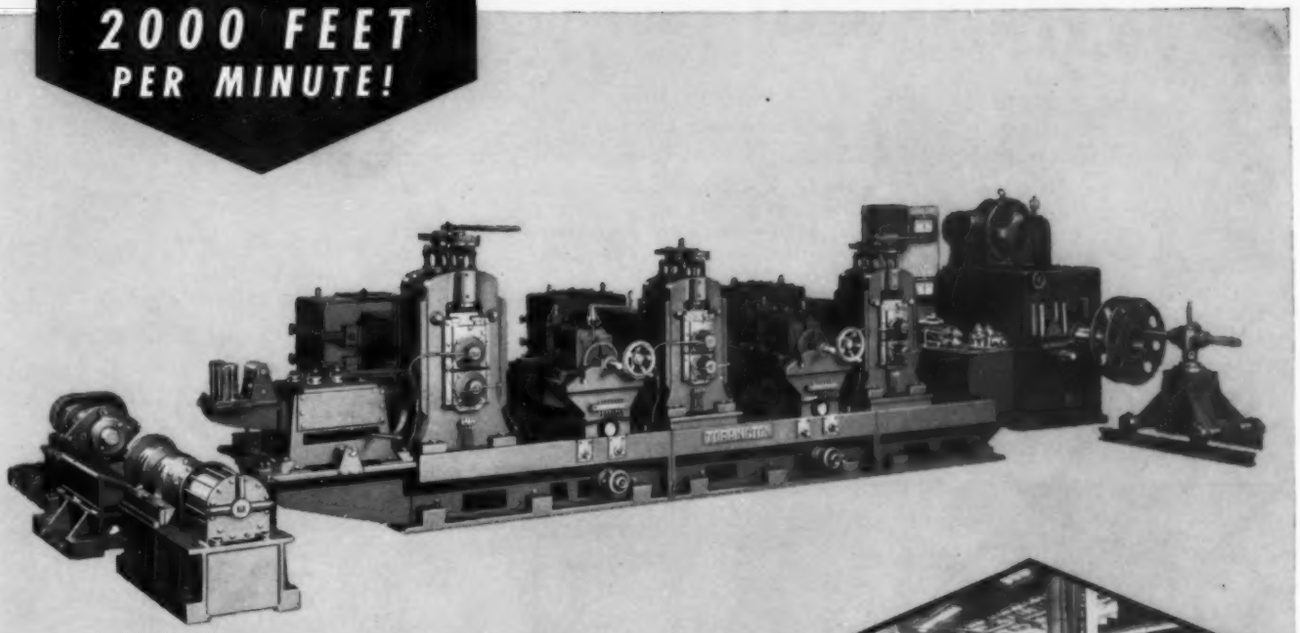
▲ Domestic freight car deliveries during February, 1949 totaled 10,315. Backlog at the end of February was 85,974 compared with 96,464 at the beginning of the month.

▲ E. J. Lavino and Co. increased their price of standard lump ferromanganese 7½ per cent for carload quantities to $172.00 per gross ton.

▲ Blast furnaces in the United States and Canada consumed 7,590,471 gross tons of Lake Superior ore in January, for the highest month since March, 1944.

▲ American Can Co. reported sales for 1948 of $409,511,398 or a 21 per cent gain over 1947. About $29,000,000 was spent for plant and equipment in 1948.

2000 FEET PER MINUTE!



TORRINGTON'S *NEW, HIGH SPEED* FLAT WIRE MILL

On the job in Western New York!

This tandem flat wire rolling and edging equipment produces flat, square or rectangular shaped wire from round or oval hot rolled rod or wire. In Torrington flat wire mills, the metal passes successively from the pay-off through breakdown rolls, grooved edging rolls and final finishing rolls onto a winder. Magnetic gauges measure the wire between finishing rolls and winder.

Precision production to thickness tolerances as exacting as .0025" and to .001" on the width is possible with Torrington Flat Wire Rolling and Edging Equipment. This unusually high degree of accuracy is the result of 60 years experience in the design and construction of auxiliary mill equipment.

Call or write Torrington today for more information and name of nearest Torrington representative.

- ★ Individual motor drive for each flattener stand!
- ★ Automatic adjustable constant tension on pay-off and winder!
- ★ All rolls in pre-loaded precision type bearings!
- ★ Driven edging rolls after each stand except finishing stand!
- ★ Magnetic gauges for continuous gauging of wire thickness and width!
- ★ External coolant system for work and rolls!
- ★ Internal cooling on flattening rolls!
- ★ All gearing totally enclosed and running in oil!

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MANUFACTURING COMPANY
TORRINGTON, CONNECTICUT

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Is UPKEEP COST your magnet problem?

Although it looks and lifts like new, this Ohio Magnet is actually 22 years old. Until recently, upkeep cost was zero. Then a ground developed in the terminal box and the magnet was shipped to our plant, where repairs were quickly completed without disassembly.

Upkeep cost? Under $100—*less than $5 a year for 22 years!*

Next time you buy a lifting magnet, remember that heavier construction assures extra years of low-cost life. Send your order to Ohio—*25 years a leader in magnetic materials handling.*

This magnet averaged less than $5 a year!

OHIO PROTECTO-WELD MAGNET is welded *on top,* where weld cannot be dented in. Sizes include 39, 46, 55 and 65-inch diameters. Ohio also builds magnet control equipment.

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ohio MAGNETS

A-2012

Industry News...

BELT CONVEYORS PROPOSED FOR LAKE-TO-RIVER BULK MATERIALS HANDLING

▲ Hauling millions of tons of iron ore and coal cross country by conveyor belt from Lake Erie and Ohio River terminals to Pennsylvania and Ohio steel plants is one grandiose industrial dream that may be nearing reality.

Plans for realizing such a scheme, seemingly as fantastic as a Paul Bunyan tale, were disclosed here by H. B. Stewart, Jr., president of the Akron, Canton & Youngstown Railroad. He announced formation of a new corporation, the Riverdale Belt Conveyor Lines, Inc., which hopes to build a two-way 130-mi conveyor belt system from Lorain, Ohio, on Lake Erie to East Liverpool, Ohio, on the upper Ohio River.

The $210 million system would haul soft coal northward from Pennsylvania, Ohio and West Virginia mining fields to the steel and industrial centers of Youngstown, Akron, Cleveland and Lorain. Southbound, the belt would carry iron and limestone to steel furnaces in the Youngstown and Pittsburgh areas.

Main lines of the proposed system would stretch 103 mi between the two terminal points. Spur lines to Youngstown and Cleveland would bring the total belt distance to 130 mi. The project whose completion would be at least five years hence, also includes the building of modern dock and terminal facilities, stockpiling points and a coal washing plant.

A total annual movement of 30 million to 40 million tons of coal, iron ore and limestone, speeding along on electrically-driven conveyor belts at 600 fpm, is anticipated. Annual savings in bulk freight costs to iron ore and coal consumers is estimated by proponents at $20 million to $45 millions.

The conveyor would be an elevated steel tube, 18 ft wide and eight ft high, designed to house two belts operating in opposite directions. The structure would have a minimum clearance of 22 ft over highways, railroads and farm lands. Movement would be controlled by push buttons with electric eye warning devices set up to locate trouble spots. About 388 employees would be needed to run the system.

The two-way main belt line would require 172 belts or "flights," some of them more than a mile long, to lift cargoes over hills and grades. Coal would move northward at the rate of 600 fpm or 3400 tons an hour. Iron ore would move southward at the same speed but tonnage carried would be 5400 an hour because of greater weight for the same volume.

A 62-in.-wide belt would move southward from Lorain on the lake 82 mi to a point near Salem Junction, 1280 ft above sea level. From there farther southward 22 mi to East Liverpool on the river, a 72-in.-wide belt would carry cargoes. The Cleveland spur, branching off the main line near Parma, Ohio, would be nine miles long and requires 10 flights of belts while the Youngstown spur would be 19 miles long with 35 belt flights.

Mr. Stewart indicated the Akron, Canton & Youngstown would operate the conveyor system as a common carrier on a contract basis at a three cents a ton fee.

The volume of iron and coal now moving by rail across the northeastern part of Ohio is sufficient to pay off construction costs of the belt system in 20 years, according to Mr. Stewart. He estimated rates could be set low enough to save companies from '50 cents to $1.50 a ton on coal shipments and 43 cents to 68 cents a ton on iron ore delivered to steel mills in Youngstown and Pittsburgh.

The system would require a minimum volume of 30 million tons of iron ore and coal a year for amortization of the project in 20 years, added Mr. Stewart, although capacity operation would be necessary to obtain maximum savings. Potential conveyor volume is estimated by him at 62 million tons a year.

Construction costs for the belt line are estimated at $154 million. Terminal facilities, designed to save turnaround time for Great Lakes ore vessels and to provide more efficient handling of coal and ore on the Ohio River, and a coal washing plant would cost an additional $56 million.

It would take about three years to build the conveyor system which would be enclosed to permit year-round operation, according to Mr. Stewart. It will be at least a year from now before engineering plans are completed. Engineers of the Goodyear Tire & Rubber Co., a leading producer of rubber conveyor belting, and the Link Belt Co., of Chicago, as well as construction, transportation and electrical experts have been working on the project for several months.

The immediate hurdle to be surmounted, declared Mr. Stewart is passage of a law by the Ohio legislature giving the Riverlake Belt Conveyor Lines the power of eminent domain. Such authorization is needed to obtain the necessary right of way for land on which to build the new system. Ohio Public Utility Commission regulations make no provision for such a transportation system.

A bill granting eminent domain

Main lines of the proposed system would stretch 103 miles between spur points. Spur lines would make total belt distance of 130 miles. (*Photograph courtesy of Life Magazine.*)

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Air Products Generators
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The raw material, air, is free. You invest nothing for equipment. You'll find operation of Air Products generators is simple and requires little time; that the rental is fair and the advantages many:

- You avoid delivery failures.
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- You assure your supply at low cost.

These same generators also produce high-quality nitrogen gas.

If you use 200,000 cubic feet of oxygen per month or more, it will be of great advantage to you to make your own with Air Products generators.

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Let us know how much oxygen you use per month, minimum and peak demands; whether you own a pipe line and storage bank, and any other pertinent information. We will show you how to improve your oxygen service at very substantial savings, as many other firms have done.

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authority to the new corporation is scheduled to be introduced in the Ohio legislature. If it failed of passage in the current session, such a measure would likely be dead until the next regular legislative meeting in 1951.

MINGO BLAST FURNACE READY TO PRODUCE

▲ A blast furnace formerly owned by the Carnegie-Illinois Steel Corp. is being rushed into production at the Mingo works of Wheeling Steel Corp. near Steubenville, Ohio. It has a potential daily yield of 700 tons of pig iron. More than 100 workers will be added to Wheeling's present Mingo payroll of 732 after the furnace goes into operation.

The furnace is one of three acquired by Wheeling from Carnegie-Illinois in 1944. The other two resumed production in 1948, but a decision to rehabilitate the third was not reached until recent weeks.

BRIGGS PURCHASES UPPER UNION MILLS

▲ Briggs Manufacturing Co., has purchased the Upper Union mills of Carnegie-Illinois Steel Corp. in Youngstown, Ohio.

Work will be started immediately to remodel a part of three buildings to house a sizable, up-to-date stamping plant, which will be in operation the early part of April.

It is estimated that more than 1000 people will be employed on this operation when the plant is in full production.

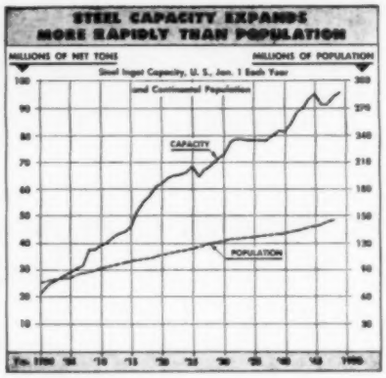
The purchase price of the property was not disclosed, but it is expected that Briggs will eventually have several million dollars invested in its Youngstown operation.

EXPAND WIRE MILL AT CFI PUEBLO PLANT

▲ Colorado Fuel & Iron Corp. is expanding its wire mill in Pueblo, Colo., to handle the greater supply of rod anticipated from its new rod mill in Pueblo, expected to begin operations early in September. Structural work on the rod mill has been virtually completed, and installation of equipment has begun.

Among the major expansions at the wire mill is the setting up of 14 new Vaughn wire drawing machines. A fourth galvanizing pan will also be installed to take care of fine wire production from the Vaughn equipment which will be used for netting purposes. A Wean poultry netting machine capable of producing two-in. locktwist netting at 135 feet per minute has already been delivered, and two more are due by spring. Wire fabric equipment is also scheduled to arrive in a few months.

New handling equipment will be installed in the wire drawing room, the nail room and the galvanizing room.



The above chart shows that the U. S. steel capacity is approximately 1300 lb per person. This is a considerable increase over 1940, when it was 1140 lb per person, and disproves recent statements that the steel industry is not keeping up with population growth.

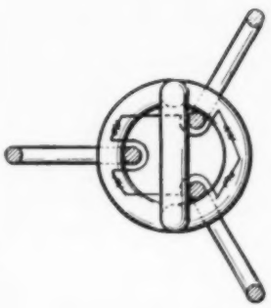
JANUARY PRODUCTION IS OVER 8,000,000 TONS

▲ Production of steel exceeded 8,000,000 tons a month for the first time in January, the American Iron and Steel Institute announced. The total of ingots and steel for castings was 8,172,236 net tons, which exceeded the entire 1948 output in any other country except Great Britain and Russia.

This new high level was an increase of 401,000 tons over December 1948, and nearly 700,000 tons over January 1948. The latter is an unusually large gain compared with previous year-to year comparisons.

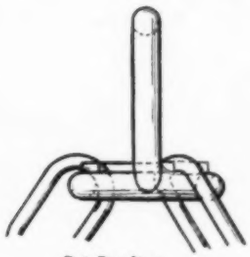
Steelmaking furnaces of the indus-

...LONGER LASTING MAGNET CHAINS



The use of heat-treated high alloy steel throughout suspension makes periodic annealing unnecessary.

Our FRICTIONLESS chains last up to 3 times as long as old-style suspensions. Write for prices. Prompt shipment from stock.



Pat. Pending

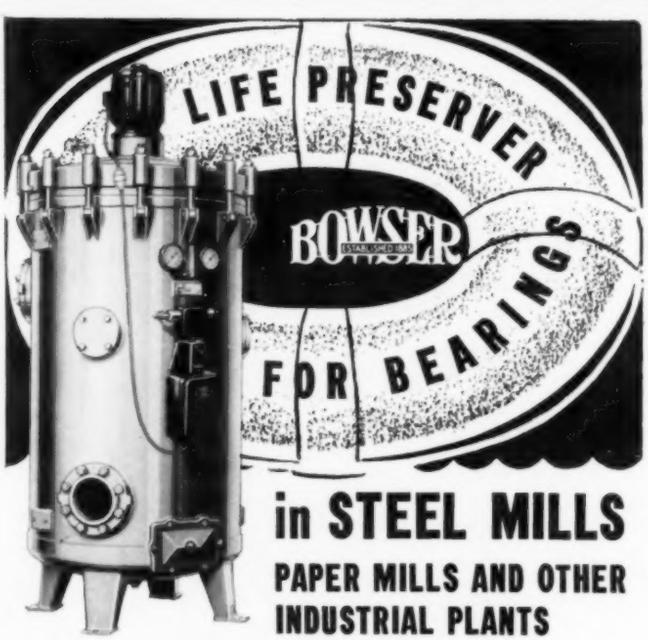
Ring plate keeps chains separated by 120 degrees. No rubbing or twisting and keeps magnet level.

Suspension chain for 55" magnet tests to 89,000 pounds.

Suspension chain for 65" magnet tests to 115,000 pounds.

DOWNTOWN *Company*

1836 EUCLID AVE. • CLEVELAND 15, OHIO



in STEEL MILLS

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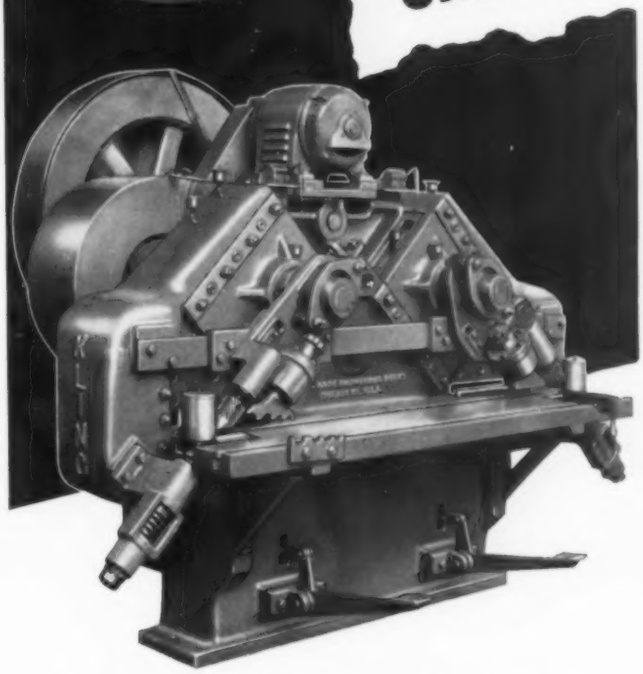
Bowser engineers have a record for cutting costs in many plants. They're at your service NOW. Please write to Bowser, Inc., 1314 Creighton Ave., Fort Wayne 2, Ind.

LIQUID CONTROL SPECIALISTS SINCE 1885

SLASH SHEARING COSTS

with

Kling Double Angle Shears



Especially designed for high speed, high production shearing. Will handle flat and round mild steel bars in addition to structural and bar angles. Round bars and bar angles are sheared on the left side, while the right side is used for structural angles and flat bars.

These special shears are equipped with automatic hold downs and "Y" type roller supports, also a removable guide for flat bar shearing. Recommended for straight shearing only. Mitreing can be accomplished by removal of holddowns. Available in four sizes.

Write today for full particulars.

Kling BROS. ENGINEERING WORKS

Manufacturers of Rotary, Plate Bar Shears Combination Shears, Punches and Copers, Single and Double End Punches, Angle, Beam, Bar and Plate Benders High Speed Friction Saws.

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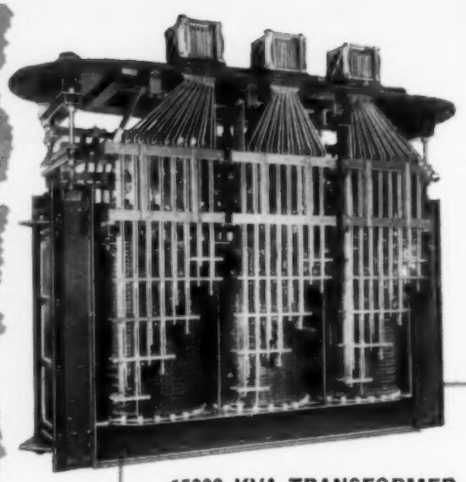
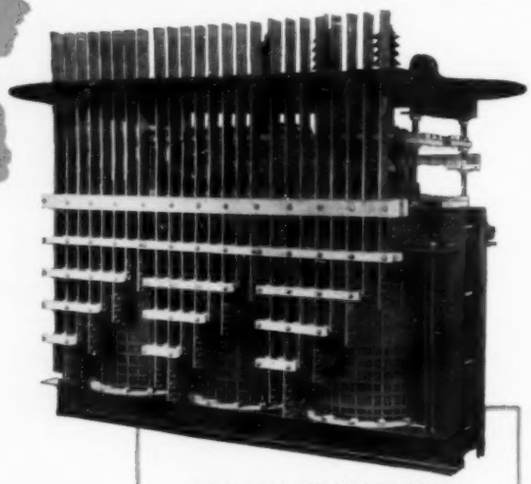
Over
1 MILLION KVA
of Pennsylvania Furnace Transformers
Now in Service!

YES, Pennsylvania Furnace Transformers, totaling over 1 Million KVA, are supplying power to hundreds of electric furnaces. The successful operation of these transformers has given Pennsylvania Transformer Company a noted reputation in the Furnace Transformer field. For over 35 years, Pennsylvania Engineers have closely followed the development of Electric Furnaces. They fully understand the problems of Electric Furnaces and their relation to Furnace Transformers.

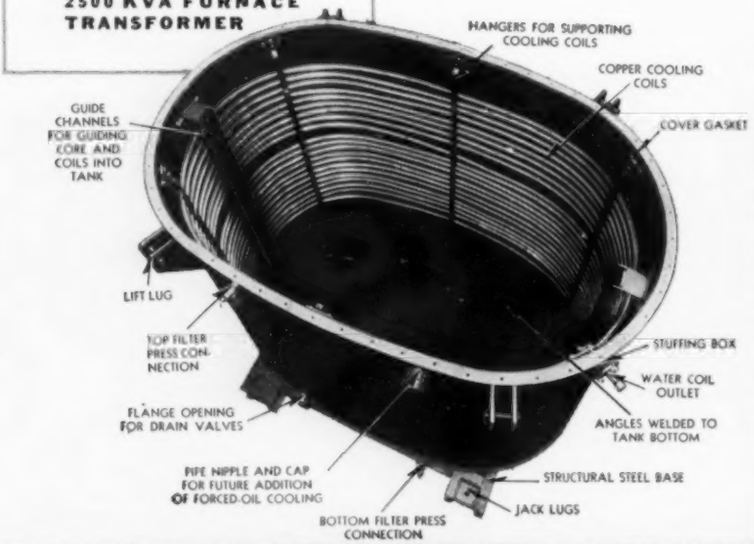


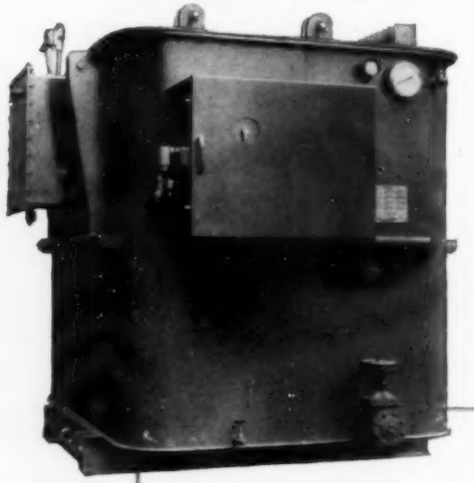
15000 KVA TRANSFORMER
for operating a 75-Ton Furnace



5000 KVA TRANSFORMER
for operating a 15-Ton Furnace

TANK INTERIOR OF 2500 KVA FURNACE TRANSFORMER


HANGERS FOR SUPPORTING COOLING COILS
COPPER COOLING COILS
GUIDE CHANNELS FOR GUIDING CORE AND COILS INTO TANK
COVER GASKET
LIFT LUG
TOP FILTER PRESS CONNECTION
STUFFING BOX
WATER COIL OUTLET
FLANGE OPENING FOR DRAIN VALVES
ANGLES WELDED TO TANK BOTTOM
PIPE NIPPLE AND CAP FOR FUTURE ADDITION OF FORCED-OIL COOLING
STRUCTURAL STEEL BASE
JACK LUGS
BOTTOM FILTER PRESS CONNECTION



7500 KVA TRANSFORMER
for operating a 30-Ton Furnace

Pennsylvania TRANSFORMER COMPANY

Pennsylvania TRANSFORMERS

Furnace Transformer Experts

PITTSBURGH 12, PENNSYLVANIA

try were operated at an average of 100.1 per cent of the new record high capacity. It was the third recent month in which operations were at or above 100 per cent, the other two being October and November, 1948.

The January output indicates the ability of the industry to make a lot more steel in 1949 than the total of 88,533,000 tons reported for last year.

RUST CONTRACTS TOTAL OVER 300 DURING 1948

▲ Reviewing activities of Rust Engineering Co., Pittsburgh, Pa., S. M. Rust, Jr., president, reported that in the past year the company engaged in work on more than 300 contracts. This work took Rust engineers and construction specialists around the world, to New Zealand, into Canada, and into many states of the U. S. This year projects now underway and under contract are expected to more than match this record for volume, variety of facilities, and geographical area covered.

The company began 1949 with engineering, executive and administrative offices located in the newly purchased Rust Building, at 575 Sixth Ave., Pittsburgh, into which it moved in December.

Rust engineers were engaged during 1948 in nearly every industrial field, including design and construction of 54 reinforced concrete and radial brick chimneys, ranging up to 525 ft in height and erection of more than 60 boiler settings, as well as other specialty work. Some of their major projects are as follows:

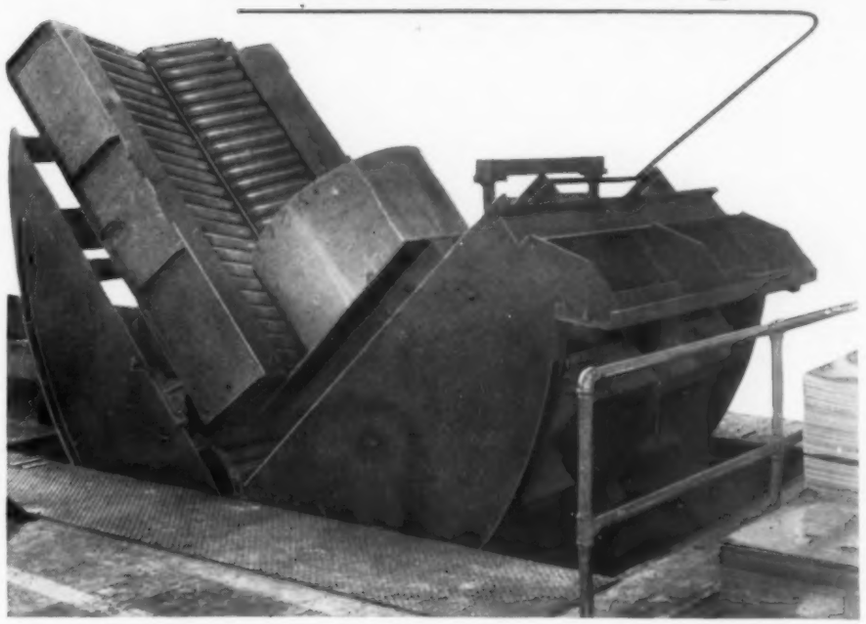
Installation of foundations and erection of strip mill rolling machinery and processing lines is now being done for the Crucible Steel Co. of America at Midland, Pa.

Some of the furnace work of the Rust Furnace Co., a subsidiary, includes construction of an 85-ton per hour billet heating furnace for the Timken Roller Bearing Co., Canton, Ohio, replacing a 40-ton Rust-built furnace in continuous use since 1929.

Work was completed on the world's only installation of five slab heating furnaces in one battery at Carnegie-Illinois Steel Corp.'s 80-in. mill, Gary works, Gary, Ind. Each of the five has a capacity of 115 tons per hour.

New furnaces also were built for

" never send a boy...



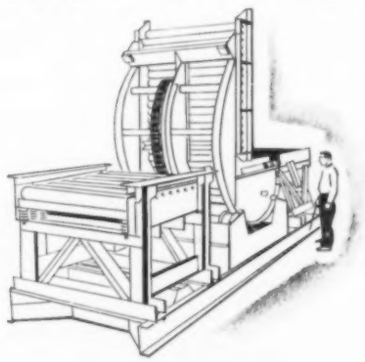
...to do a man-sized job"

. . . and coil handling today is certainly just that.

Mathews' Engineers were developing Gravity and Power Conveyers and special conveying machinery for the Steel Industry way back when an 8,000 lb. coil was called **heavy.** As these weights have increased over the years, the Industry has demanded heavier, more rugged conveyer units—conveyers which can stand the terrific beating of continuous steel mill service.

Today, Mathews coil-handling conveyers and special coil manipulating machinery are handling coils weighing as much as 50,000 lbs.

Give your heavy handling problem to Mathews' Engineers and let them go the limit in building into the equipment the weight the job demands. They make available to you the benefit of many years of experience in applying conveyers in heavy industry.



Heavy-duty, spring-mounted coil upenders and side-tilters, typical examples of Mathews engineered machinery for modern steel mill service.

MATHEWS CONVEYERS

GENERAL OFFICES . . . . . *Mathews Conveyer Company*
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CANADIAN DIVISION . . . . . *Mathews Conveyer Company, Ltd.*
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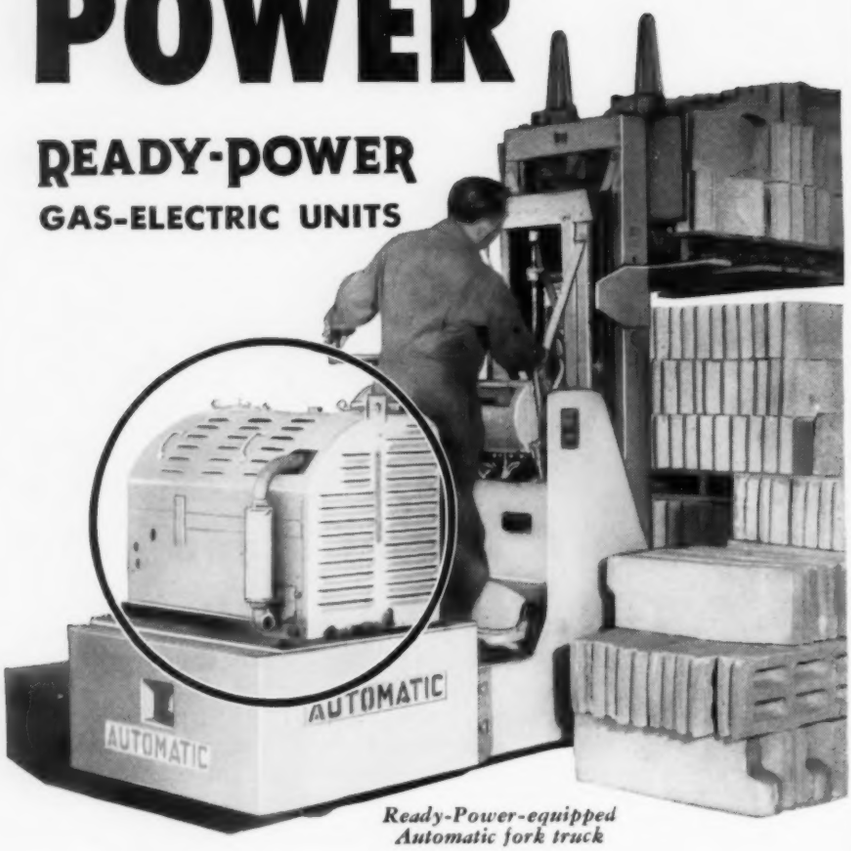
PLENTY OF POWER

READY-POWER
GAS-ELECTRIC UNITS



Ready-Power-equipped Automatic fork truck

There is only one way to provide plenty of power for an electric truck—wherever and whenever needed—and that's to generate it constantly right on the truck chassis. Ready-Power gas-electric Power Units do just that, and do it efficiently and economically hour after hour, day after day. Specify Ready-Power on new truck purchases. Write us direct for information on converting present equipment to Ready-Power.

Ready-Power-equipped Crescent platform truck with dump hopper

THE READY-POWER CO.

3836 Grand River Ave., Detroit 8, Mich.

Pittsburgh Piping and Equipment Co., Pittsburgh, and Benjamin F. Shaw Co., Wilmington, Del., for heat treatment of complex pipe assemblies, and a stress relieving furnace for Flint Steel Corp. at Tulsa, Okla.

Work on the nation's largest low pressure steam generating plant, which will cost an estimated $4,500,000, was far advanced at the Pittsburgh South Side works of Jones and Laughlin Steel Corp., with two boilers on the line and the other three to be completed shortly.

The new $2,250,000 steam and electric generating plant for the John A. Roebling's Sons Co. at Roebling, N. J. was placed in operation. It replaces an older steam plant, and is designed to produce savings through the generation of by-product electrical energy.

Modernization of a steam generating plant for Crucible Steel Co. of America at its Midland, Pa., works, will replace 10 Rust boilers, which have been in continuous use for over 43 years, with 2 new Rust units.

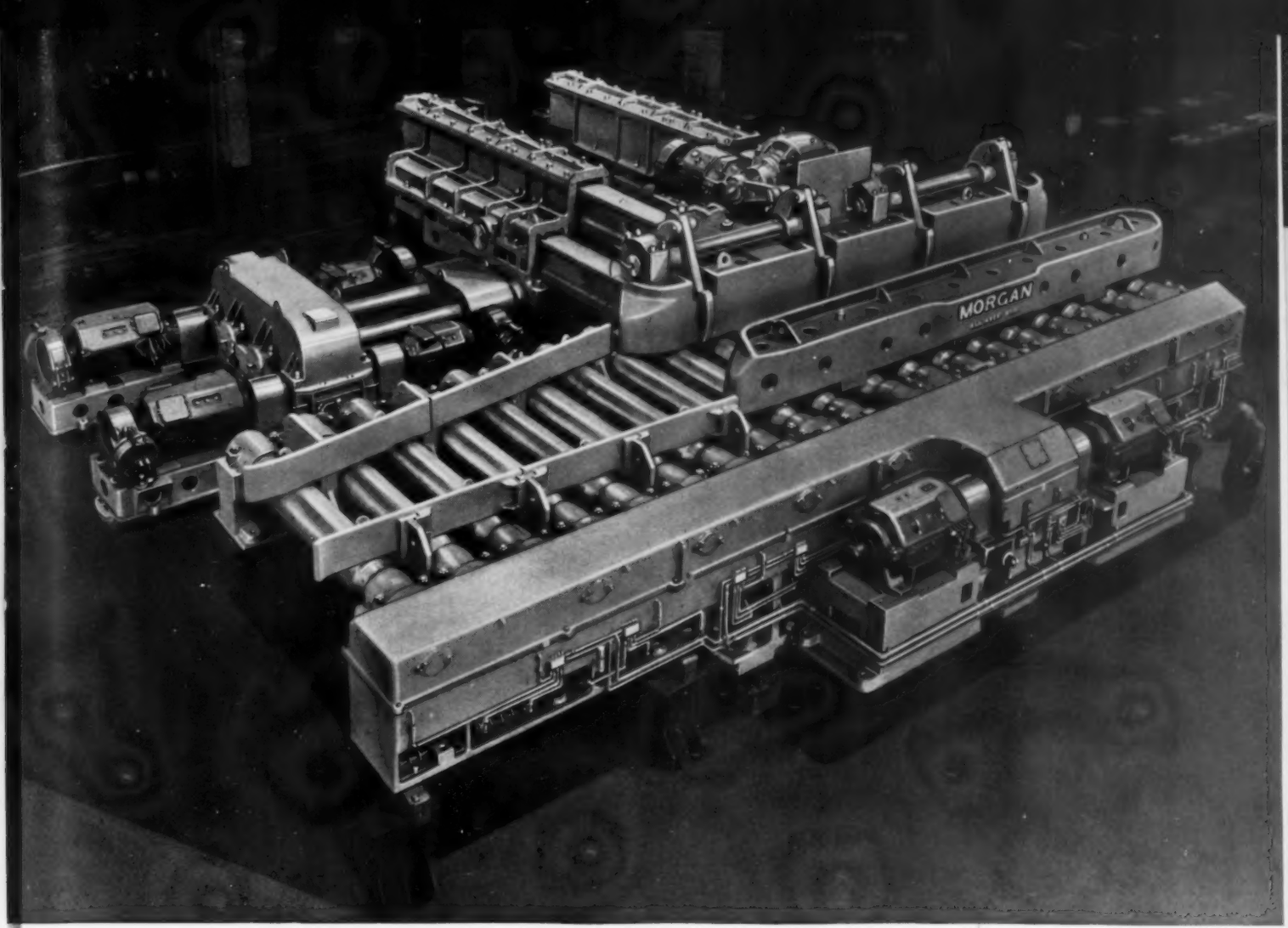
For Bird & Son, Inc., a leading producer of asphalt roofings, sidings, floor coverings and paper products, Rust designed and began installation of a new high voltage electric generating and distribution system at its East Walpole, Mass., plant.

Design and contracting jobs are also under way by Rust in the glass, chemical, refining, food, paper, and other industries.

McNEIL MACHINE BUYS CLEVELAND CRANE

▲ The Cleveland Crane & Engineering Co., Wickliffe, Ohio, has been purchased outright by McNeil Machine & Engineering Co. of Akron, Ohio. Plans have already been made to continue operating Cleveland Crane as heretofore, with no changes in over-all management, organization, or policies. For all practical purposes the company name will remain the same. The only change contemplated is merging the two companies with the thought that later on stock of the combined companies will be offered to employees and the public.

The Wickliffe, Ohio, firm was organized in 1899 as the Cleveland Crane and Car Co., and from the very beginning has been engaged in the manufacture of heavy overhead traveling cranes, which still continues to be an important part of its business.



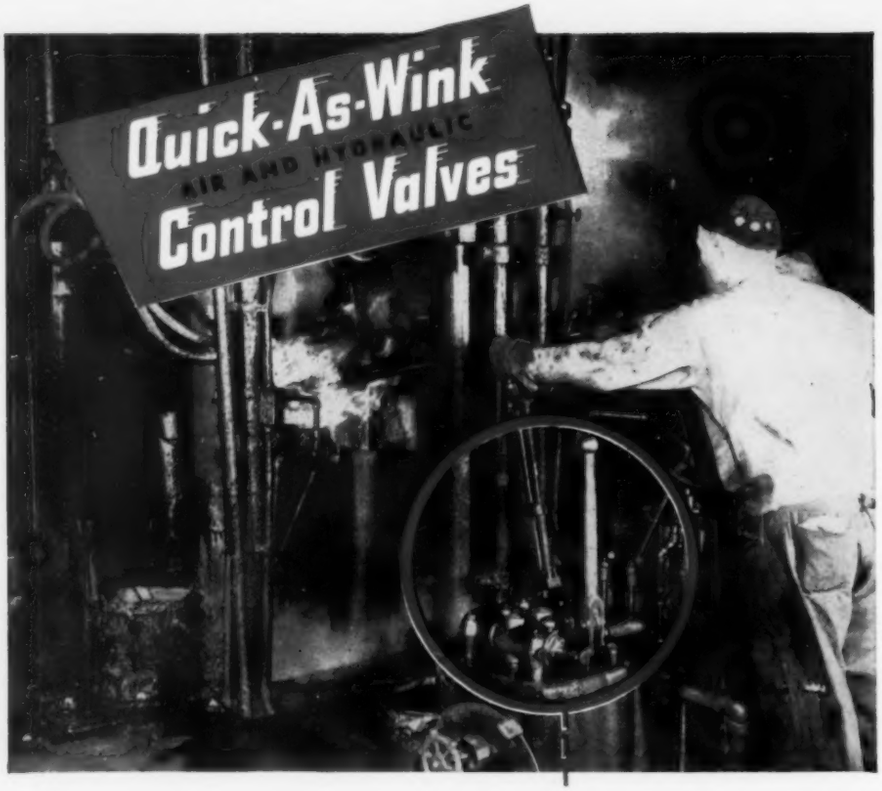
45″ BLOOMING MILL TABLE AND MANIPULATOR

Morgan 45″ Blooming Mill Manipulator with Front Mill Table. Manipulator is of the overhead type, electrically driven, with retractable heads so the table rollers can be removed without dismantling the manipulator heads. Table girders are of cast steel box section type with integral oil trough on drive side. All gears are totally enclosed, operating in oil, and have hardened teeth. All bearings are of the anti-friction type lubricated through a centralized motor operated system.

BUILT BY MORGAN Engineering

THE MORGAN ENGINEERING CO.
ALLIANCE, OHIO PITTSBURGH—1420 OLIVER BUILDING

DESIGNERS • MANUFACTURERS • CONTRACTORS • BLOOMING MILLS • PLATE MILLS
STRUCTURAL MILLS • ELECTRIC TRAVELING CRANES • CHARGING MACHINES • INGOT STRIPPING
MACHINES • SOAKING PIT CRANES • ELECTRIC WELDED FABRICATION • LADLE CRANES • STEAM

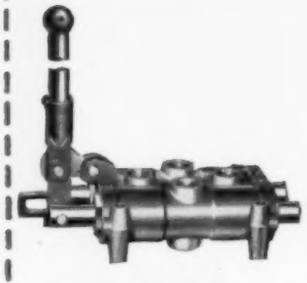


Service built in beneath the surface

● It isn't what you see—but the working parts you can't see that's important about control valves.

Positive and fast acting with U-shaped packers that are expanded by the pressure, Quick-As-Wink Control Valves seal tightly preventing leakage and bleeding. All operating parts are in pressure balance eliminating any tendency to creep or crawl. There is no lapping—no grinding—no metal to metal seating. Every valve is a high quality control—precision made—and individually tested before being shipped. This assures users a maximum of long, efficient, trouble-free service.

Furnished in hand, foot, pilot, solenoid and diaphragm operated designs for controlling all types of air and hydraulic equipment. Let us work with you on your requirements!



Quick-As-Wink Lever Operated Hydraulic Valves

The MF-651-N4 pictured above is a four-way neutral position valve, for controlling double acting cylinders. It can also be furnished with three position "compound-exhaust", or "compound-on" actions. Recommended for use with oil or water up to 150° F. and 2000 PSI. Other types for pressures up to 5000 PSI, —but send for a catalog today and get *full* details about the *complete* line.

Quick-As-Wink Control Valves

THE HIGHER THE PRESSURE THE TIGHTER THE SEAL

Manufactured by **C. B. HUNT & SON, Inc.,** *Salem, Ohio.*

Engineering and Sales Representatives in the Principal Cities

In 1919 the Cleveland Tramrail line of overhead materials handling equipment was developed.

In 1931 the company began diversifying beyond the materials handling field and developed a complete line of press brakes, known as "Steelweld" bending presses. In 1945, after many years of perfection, a line of heavy metal cutting machines, known as "Steelweld" pivoted-blade shears, was introduced.

The Akron concern was formed in 1862 as the J. C. McNeil Co. It is operated by C. F. Safreed, president; A. S. Michelson, vice-president and treasurer; T. Henry Williams, secretary; and Frank H. Jennings, assistant Secretary-treasurer. The present owners acquired the firm in 1936 which is one of the leading manufacturers of rubber-working machinery.

Herbert T. Florence, president of Cleveland Crane, and executives now associated with him, will continue to operate the business as previously.

SALEM HEADQUARTERS IN ENGLAND MOVED

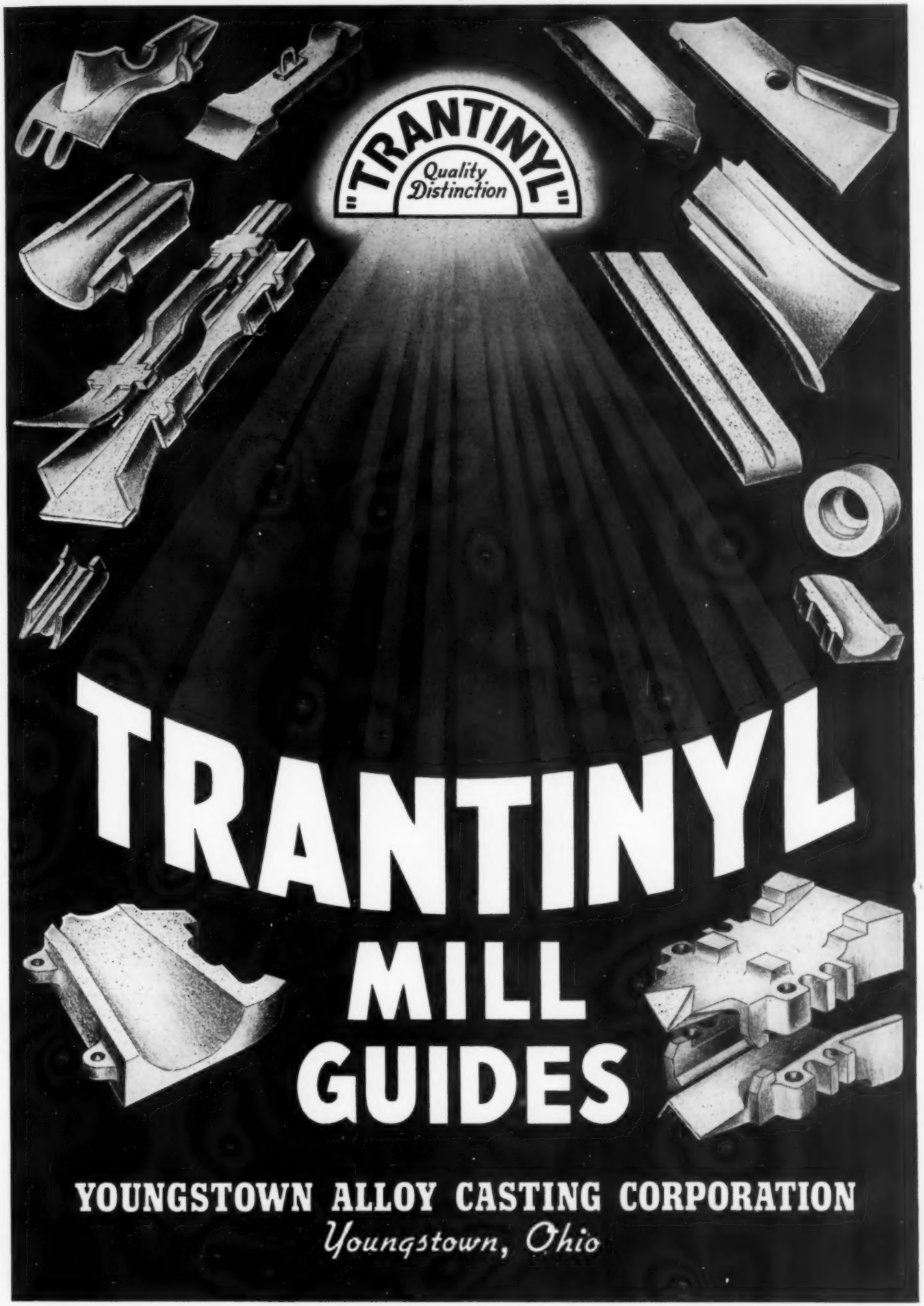
▲ The offices of the Salem Engineering Co. Ltd., for England and the British Empire are now located in Milford House, Milford, Nr. Derby, England, having removed engineering and manufacturing facilities from Sheffield, England. Their telephone number is Duffield 2271, and the cable address is "Keener, Belper."

Salem Engineering Co., Ltd., also maintains an office in London, England, at 147 Victoria Street, Westminster, London, S. W. 1. In Canada, Salem Engineering (Canada) Ltd. is located at 1525 Bloor Street, West, Toronto, Ontario. The main office is the Salem Engineering Co. at Salem, Ohio.

LEBANON FOUNDRY HAS NEW CASTING PROCESS

▲ Completion of a $500,000 plant expansion program for Lebanon Steel Foundry, Lebanon, Pa., was announced by William H. Worrilow, president.

Doubling the company's high-alloy steel casting facilities, the new plant addition and unique equipment installations are specially designed for the production of super-alloy castings under secret processes developed by Firth-Vickers Stainless Steels, Ltd.,


TRANTINYL
Quality Distinction
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MILL
GUIDES
YOUNGSTOWN ALLOY CASTING CORPORATION
Youngstown, Ohio

leading British steel casting concern, of Sheffield, England.

Opening the door to complex new metallurgical, engineering and design applications, the British-developed process of centrifugal casting in permanent molds, known as Centri-Die casting, was described by the Pennsylvania industrialist as one of the most important improvements in a generation of alloy-steel foundry progress.

While the process now exclusively licensed to Lebanon is specifically adapted to the production of high-melting-point alloys, and thus is of immediate importance in turbojet and turboprop engine manufacture, where requirements of terrific heat resistance and corrosion resistance must be met, it lends promise of adaptability in a variety of new uses.

The Centri-Die technique is said to be exceedingly versatile, and applicable as well to the production of alloyed materials not now commercially available — particularly in the direction of tubular or cylindrical structures which are difficult or impossible to forge or cast by any other method.

The new plant structure, comprising a 22,400-sq ft addition to Lebanon's high-alloy plant, is 160 ft long and 140 ft wide, including two 40-ft bays and one 60-ft bay. Ceiling height is 36 ft in the main bay and 22 ft in the smaller. Structural steel framing supports a roof of precast concrete slabs, and wall construction is of modern glass block and brick. Wood block and concrete flooring is used throughout.

Two five-ton overhead traveling cranes are in operation in the new building and extend into the original high-alloy plant, covering an overall operating expanse of 320 ft.

Two additional electric induction furnaces have been installed, and two rotary cold saws and five new centrifugal casting machines have been added to round out the specialized equipment in what is considered to be the most modern high-alloy steel casting plant in the nation.

Specially designed for use in connection with the Firth-Vickers process, the five "spinning" machines were built to Lebanon Steel Foundry's order by the Centrifugal Casting Machine Co., of Tulsa, Okla., and incorporate a number of design innovations. Three of these centrifugal units are of vertical type, and two are horizontal type.

Together, the five new machines are designed to cover all phases of varied centrifugal casting requirement arising in diversified foundry practice. One of the units has the capacity to spin a combined load of 10,000 lb of molten metal and die, at a maximum speed of 1200 rpm.

WEAN TO HANDLE BIGWOOD MACHINERY

▲ Wean Equipment Corp., Cleveland, Ohio, recently concluded an agreement with Joshua Bigwood and Son, Ltd., Wolverhampton, England, whereby Wean Equipment Corp. has entered into an exclusive arrangement for the manufacture and sale of Bigwood tube, bar, and shape straightening machinery. Bigwood, established in 1874, is one of the oldest and most experienced heavy machinery firms in England.

The main plant of the Wean Equipment Corp. is located in Cleveland, Ohio. In addition to this line of straightening machinery, the Wean Equipment Corp. specializes in the manufacture and sale of strip, wire mill, and wire fence machinery.

For Improved Drawing
and Longer Die Life

Copper-coat WIRE, ROD and TUBING
with

Cuprodine®

"Cuprodine", in a simple chemical process without current, deposits an adherent layer of copper on both mild and stainless steels. This layer acts as an effective lubricant—reduces wear and scratching of dies; prolongs die life; minimizes scratching on wire, rod and tubing; and increases the number of draws per die.

"Cuprotek"® passivates Cuprodized and other cuprous surfaces, and acts as a paint bond, or a good temporary preventive of corrosion.

Write or call Ambler 0486, for further information on both "Cuprodine" and "Cuprotek".

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AMERICAN CHEMICAL PAINT COMPANY
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Manufacturers of Metallurgical, Agricultural and Pharmaceutical Chemicals

CENTRAL IRON & STEEL INCREASES CAPACITY

▲ The Central Iron & Steel Co. of Harrisburg, Pa., a new subsidiary of the Barium Steel Corp., has spent approximately $2 million during the past year in enlargements and improvements to its steelmaking and plate rolling facilities. These improvements at Central Iron & Steel have substantially increased ingot capacity and doubled plate finishing capacity.

The most noteworthy advance has been the installation of three 96 in. shell cupolas producing hot metal for its refining furnaces, the company declares, adding: "This development was made necessary to replace the dwindling supply of pig iron and has resulted in the speeding up of its heats and has substantially increased Central's ingot capacity."

Gas producers, which formerly were used in connection with the open-hearth furnaces, have been eliminated and a change made to oil. Waste heat boilers were also added to increase steam supply. A 30 ton electric furnace, together with the necessary electrical installations, was installed.

A blooming and slabbing mill complete with auxiliary equipment is now being installed. The capacity of this mill is rated at 90 tons per hour from ingot to slabs necessary for its finishing mills. This mill should double Central's plate finishing capacity. Ingots will be heated in a modern six hole soaking pit serviced by two 15 ton soaking pit cranes. New housings, edger, shear, manipulator and tables, have been purchased and are now nearing completion.

The potential capacity of the universal mill has been increased principally by the installation of a continuous furnace, slab table and shears. This mill has been supplying skelp for the pipe manufacturers and also a slabbing mill for steel plate. When the new blooming and slabbing mill is completed, the universal mill will be used solely for finishing.

The rolling capacity of Central's 89 in. finishing mill has been increased to over 500 tons per day from its former 200 ton a day rating. A charging machine, additional shears, leveling equipment, runout and transfer tables, continuous furnace, together with an additional mill building and enlarged shipping facilities, have been installed to effect this increase.

At the 126 in. mill, new tilting tables have been added which have served to increase the efficiency of this mill. An additional shear, capable of shearing up to 2¼ in. plate, has been purchased and is being installed.

The management estimates that Central's present plate rolling capacity will be doubled upon completion of the blooming and slabbing mill and the improvements and additions currently being made to Central's other mills.

The company has changed over its steam plant from hand fired coal boilers to oil. Waste heat boilers have been installed wherever practical. Three electric hydraulic pumps have replaced the old steam hydraulic pumps which has substantially increased the available steam supply.

An additional 42 in. universal mill has been purchased for future installation. Two 4500 hp steam engines and necessary boilers have been purchased which will be adapted to power this mill.

The fabricating plant has been modernized by the addition of new equipment such as a 17 ft welding machine, 16 ft bending roll, press

Pittsburgh PIPE CLEANER COMPANY
Offers A Comprehensive Blast Furnace Program

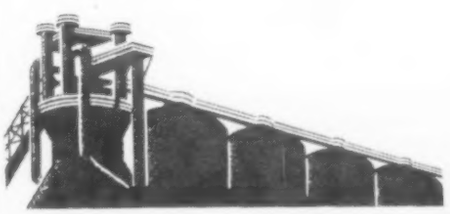
After seven years of experience and development, the Pittsburgh Pipe Cleaner Company now offers to the Iron and Steel Industry a comprehensive Blast Furnace Cleaning, Checking, and Survey Program to determine the efficiency of heat transfer in hearth jackets.

To do this job completely and successfully has required the development of a mechanical cleaning method and test procedure which are exclusive with this company.

Pittsburgh Pipe Cleaner Company Has...

★ Necessary trained personnel
★ Years of practical experience
★ Specially designed equipment
★ Engineering Knowledge
★ Handling facilities

all of which are necessary to a "COMPLETE JOB," and solve your blast furnace cleaning problems for you.



Call for an interview with one of our trained engineers. Past records prove that we have an exclusive program for you.

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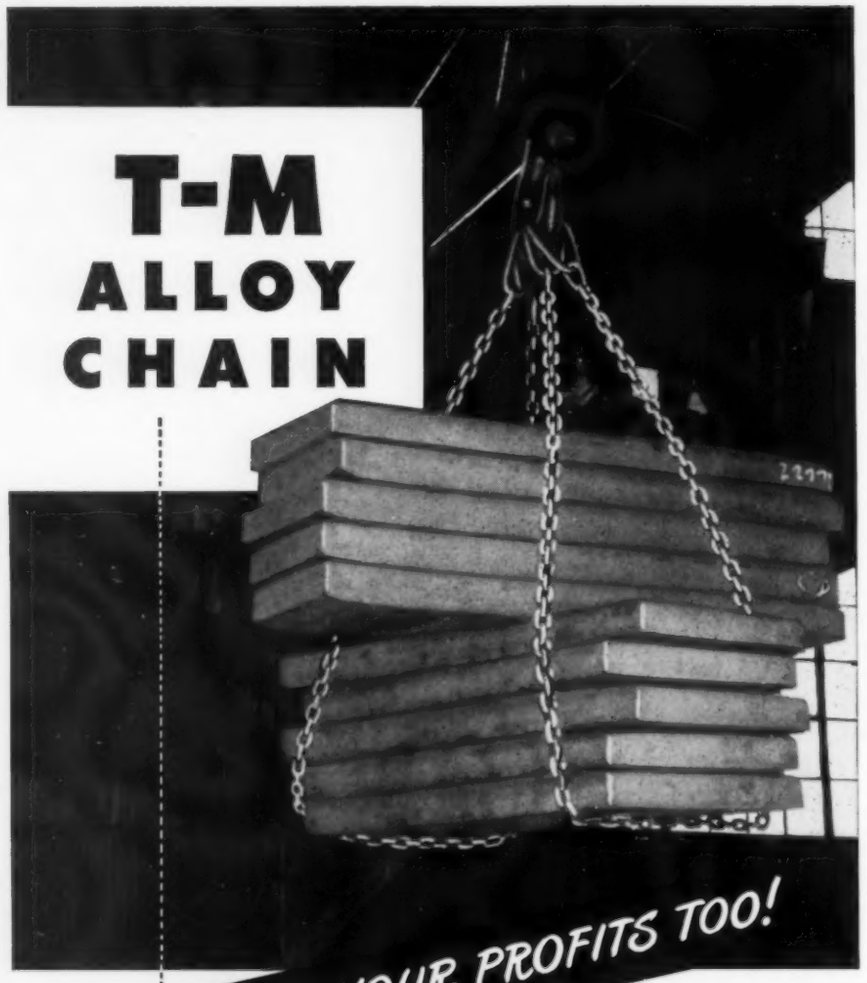
BALTIMORE • BIRMINGHAM • BOSTON • BRADENTON, FLORIDA • BUFFALO • CHARLOTTE
CHICAGO • CINCINNATI • DETROIT • HOUSTON • NEW YORK • PHILADELPHIA • ST. LOUIS



TM ALLOY STEEL CHAIN will ably meet your lifting needs *and show a marked effect on your profits too.* Extra strength means added safety. It never requires annealing or periodic heat-treating. These factors plus its ability to withstand shock, grain growth and work-hardness result in lower maintenance costs—lower replacement costs and *TWICE THE SAFETY FACTOR.* See your local mill supply distributor or write direct for literature and complete specifications.

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brakes, additional cranes and handling equipment.

BETHLEHEM CAPACITY TO GO TO 15,000,000 TONS

▲ Bethlehem Steel Co.'s steel producing capacity has been increased nearly three million tons in the last 10 years. The capacity rose from 11,247,000 tons in 1939 to 14,200,000 tons in 1948.

By the end of 1949 the steel making capacity of Bethlehem will be up to 15 million tons.

1948 STEEL SHIPMENTS WERE 65,973,138 TONS

▲ Shipments of finished steel products rose to record levels in December and the year of 1948, the American Iron and Steel Institute announced.

The year's total of shipments was 65,973,138 net tons, 2,916,000 tons larger than in 1947 and 2,700,000 tons above the wartime record of 63,250,519 tons in 1944.

December shipments totaled 6,056,282 tons, exceeding the shipments of a year earlier by more than 400,000 tons and surpassing the record of last March by 78,000 tons.

During 1948, the greatest increase in tonnage of shipments over 1947 was in sheets and strip, the total being 19,743,338 tons, a gain of 1,383,991 tons. Substantial increases also were made in pipe, plates and tin plate. Shipments of nails, alloy steel bars and reinforcing bars showed small increases over 1947.

1948 STEEL PAYROLL EXCEEDS $2 BILLION

▲ The annual payroll of the iron and steel industry exceeded two billion dollars for the first time in 1948, and was 200 per cent higher than the 1935-1939 average, the American Iron and Steel Institute announced. The estimated total was $2,234,461,000, an increase of more than 12 per cent over the previous record year, 1947.

The rise in 1948 was accompanied by increases in both employment and

wage rates. Employment rose from 620,900 in December 1947, to a post-war high of 647,600 in December 1948. The average for the full year 1948 was 635,600 compared with 616,300 in 1947. The wartime yearly maximum of employment was 647,166 in 1942.

At the end of 1948, payments to workers receiving wages were averaging $1.63 an hour compared with $0.84 in 1939. The number of wage workers meanwhile increased from an average of 425,100 in 1939 to 541,000 in 1948.

These data are based on reports from 119 companies, representing 93 per cent of the capacity of the industry. They cover employees engaged only in the production and marketing of iron and steel, excluding mining, shipbuilding, and other non-steelmaking activities.

J&L STARTS LAST OF FIVE NEW BOILERS

▲ Admiral Ben Moreell, president of Jones & Laughlin Steel Corp. applied the torch on February 18 to the last of the five new giant steam generating boilers at the Pittsburgh works. This $4½ million boiler house is a part of the J&L expansion and improvement program and will deliver nearly a million pounds of steam per hour to J&L facilities on the south side of the Monongahela River. The new boilers will replace 43 small boilers now in service at four separate locations on the south side. These small boilers are being removed from service and dismantled.

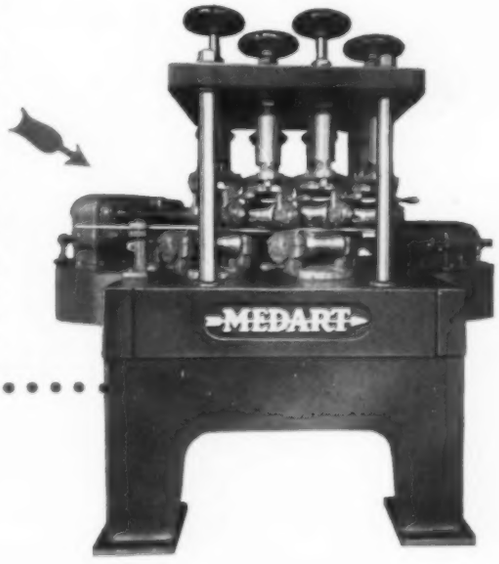
The new boilers are equipped with full automatic controls for firing with coal and the use of coke oven gas when available as auxiliary fuel. The spreader-type stokers in conjunction with high efficiency dust collectors are expected to minimize the emission of smoke and fly-ash from the boiler stacks. The spreader stoker design throws crushed coal into the combustion chamber where about 40 per cent is burned in suspension. High pressure air is injected at proper locations above the grate to increase turbulence assuring complete combustion of furnace gases and the coal which is being burned in suspension.

An additional feature incorporated in the new boiler design is the re-injection into the combustion chamber of the solids which are arrested in the high efficiency dust collectors and soot chambers.

MEDART MICRO-MULTICYCLE!

straightening machine designed exclusively for ⅛" to ½" bars and tubing.

Small, compact yet built on the same principle and embodying the same advantages as the Medart 6-in-1 Multicycle Straightener . . . positive, synchronized feed . . . one feeding level . . . two bending cycles . . . single motor . . . and the Medart Micro-multicycle has this PLUS FEATURE: all six rolls are driven! A variable feed-speed range is built into the machine. 3 H. P. motor mounted on base of machine.



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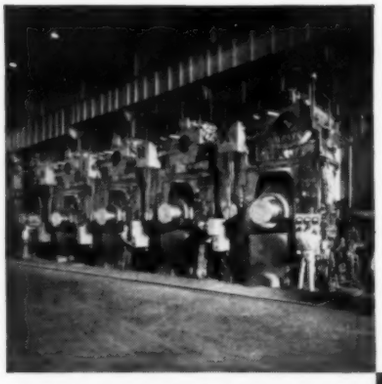
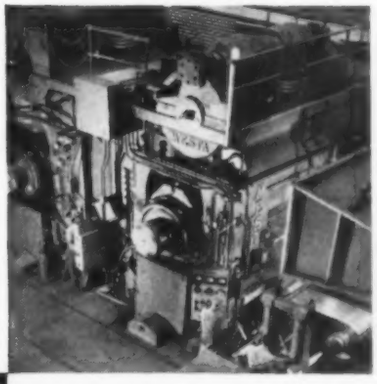
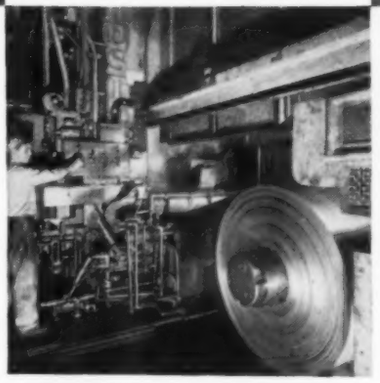


The Mesta-Built tandem cold strip mill, record setter for JONES & LAUGHLIN, is equipped with dependable Torrington 4-row Tapered Roller Bearings on work rolls to handle tremendous loads at high speed.



Mill Screw Downs, the fastest in response action ever installed in any five-stand tandem cold strip mill, put the pressure on back-up rolls through high-capacity, low-friction Torrington Thrust Bearings.



Torrington Radial and single and double-row Tapered Roller Bearings in the tension reel provide rigid support and smooth operation for coiling steel strip at high speeds.

More than 6,250 feet of steel strip a minute! That's the record set by the new tandem cold strip mill, the world's fastest, designed, built and erected for Jones & Laughlin by Mesta Machine Company.

To the work rolls, screw downs and take-up reel, Torrington Bearings – tapered, radial and thrust types – bring speedy response, greater rigidity and exceptional service life. They help keep the mill on the go with less maintenance attention.

If you want to set new production records, specify Torrington Bearings for your heavy-duty equipment. For engineering service from design to maintenance, contact our nearest office.

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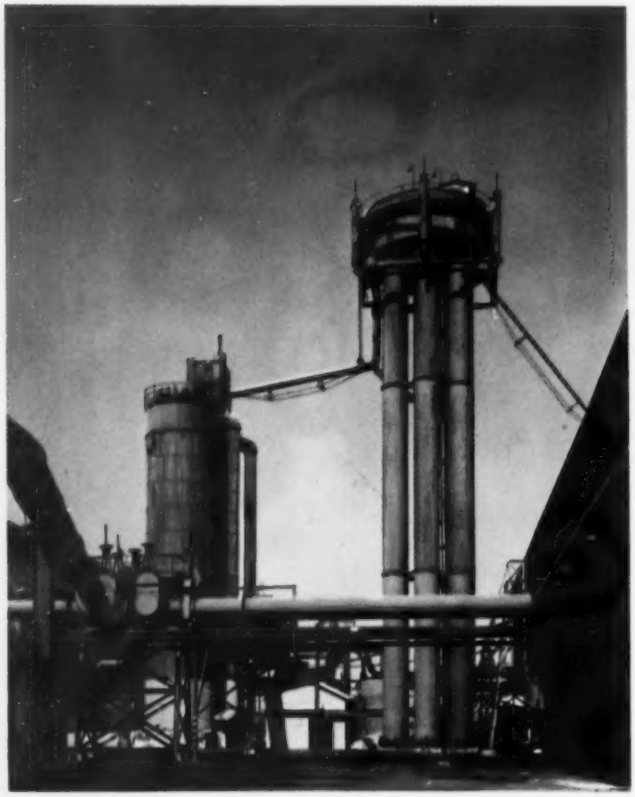
Spherical Roller • Tapered Roller • Straight Roller • Needle • Ball • Needle Rollers

This Thylox-Process Gas Purification Plant will remove 98% of the hydrogen sulfide from Coke-Oven Gas. Purified Gas contains less than 5 grains of hydrogen sulfide per 100 cu. ft.



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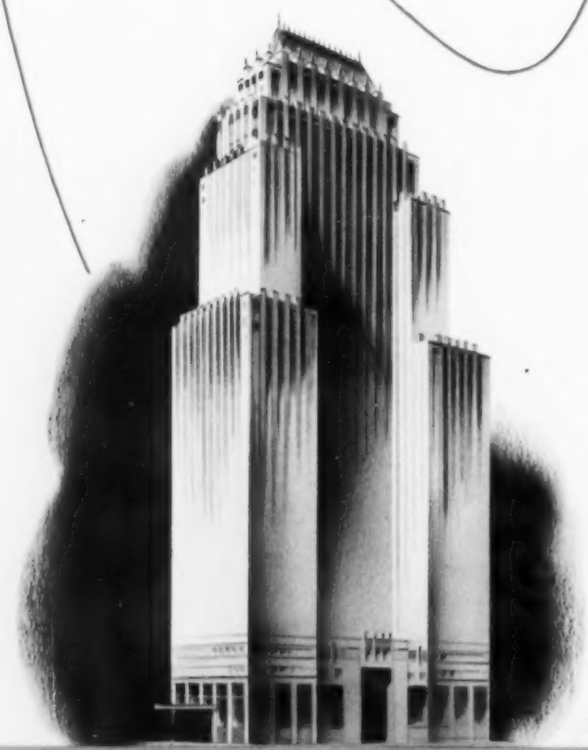


● Koppers Engineering and Construction Division is the foremost builder of coke ovens in the United States. In addition, Koppers has designed, engineered and constructed—in this country and abroad—many light oil recovery and gas purification plants, by-products recovery plants, and plants for the manufacture of a wide variety of chemicals.

Koppers is currently engaged in the construction of a completely integrated steel plant, as well as a demonstration plant to make oil and gasoline from coal.

The specialized knowledge and experience of Koppers engineers are always at your service. We invite you to consult us at any time.

KOPPERS COMPANY, INC.

ENGINEERING AND CONSTRUCTION DIVISION

Pittsburgh 19, Pa.

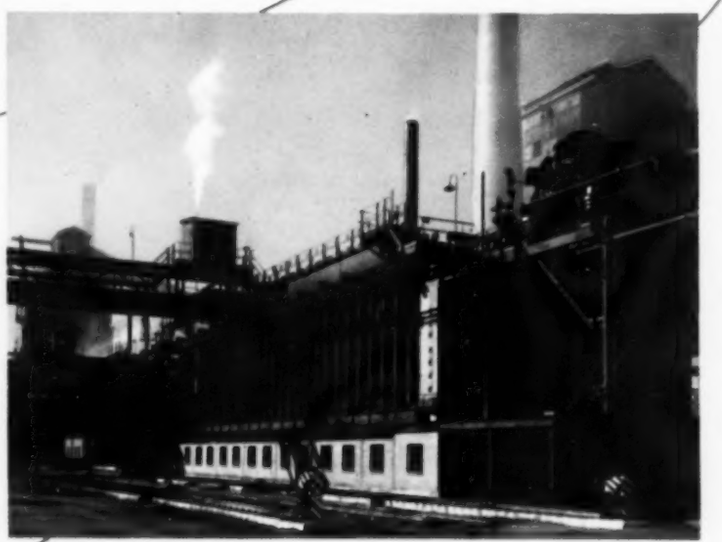
Koppers Building, Pittsburgh, Pa., Headquarters of Koppers Company, Inc.

This By-Product and Benzol Plant is equipped for the recovery of ammonium sulphate, tar, light oil and pure benzol products . . . for the recovery of by-products from the carbonizing of 1050 tons of coal daily.

First light oil refining plant in South America to produce pure benzol, toluol, xylol and solvent naphtha. Capacity is 5,000 gal. of light oil per day. It is equipped with a Koppers Continuous Automatic Wash Oil Purifier.

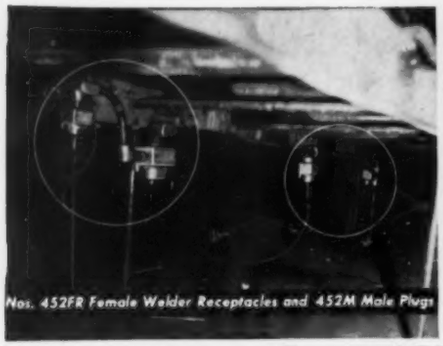
and construction

106 new Koppers-Becker Underjet Coke Ovens carbonize approximately 2600 net tons of coal per day. Built in two batteries, they are equipped with Waste-Gas Recirculation and Blast-Furnace Gas Underfiring Equipment.

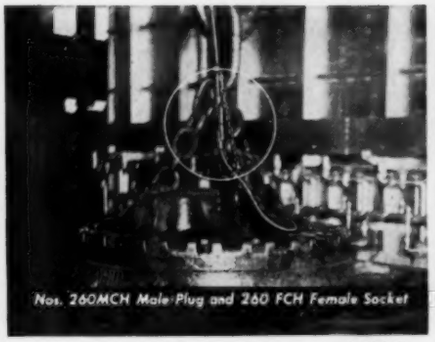


These Koppers-Becker Underjet Coke Ovens have a capacity of 580 tons of coal carbonization daily. The 25 ovens make a total of 110 Koppers-Becker Ovens at this plant. Ovens are equipped with waste-gas recirculation and coke oven gas underfiring; there is provision for future blast furnace gas underfiring.

KOPPERS



Nos. 452FR Female Welder Receptacles and 452M Male Plugs



Nos. 260MCH Male Plug and 260 FCH Female Socket

No. 452FR Female Receptacles for Welding

In Steel Mills . . . In Rolling Mills

or Where-ever Electric Current Flows

THERE'S A NEED FOR MINES CONNECTORS

They're Water-Proof

They're Shatter-Proof

And They're Jerk-Resistant

Photographs courtesy Granite City Steel Co. and Laclede Steel Co.

THEY'RE WATER-PROOF

Moisture, oil and dust—traditional enemies of an electrical connectors efficiency and longevity are excluded from Pins and Sockets in MINES Plugs or Receptacles by unique, patented designs. Normal pressure in making connections, compresses matching beads or dove-tails close fitting lips on face of connectors, providing protective enclosure of resilient Neoprene rubber for contacts.

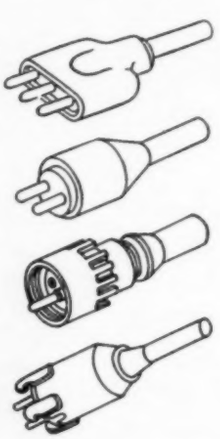
. . . . . SHATTER-PROOF

Many otherwise good connectors fail quickly when subjected to normal rough handling. Molded of Neoprene rubber into trim one piece units, MINES Plugs and Inserts easily withstand several times the "normal expectancy" of severe usage. Built for use under all kinds of operating conditions! They can't crack when dropped or shatter when run over.

. . AND JERK-RESISTANT!

Disconnecting plugs by jerks on their cables is a prevailing bad practice today. MINES plugs are built with two-way jerk-proof protection to minimize the disasterous results of such rough treatment. First, mechanical strains at soldered joint of cable connector wiring junctions are eliminated by special manufacturing process. Second, vital junction of connector to cable jacket is reinforced by a molded Neoprene neck of great mechanical strength.

4 STYLES TO CHOOSE FROM



1 OVAL PUSH-PULL STYLES — Used to best advantage when space restrictions put connectors near flooring, against walls or in narrow panel niches between necessary operating paraphernalia.

2 ROUND PUSH-PULL STYLES — Best for general all around use. Fit hand naturally thereby making handling easier and faster. Have longer protective neck taper to cable.

3 ROUND "SPB" STYLES — For heavier currents. Threaded, swivel couplings make it easy to connect or disconnect. Couplings on larger sizes revolve on ball bearings.

4 ROUND PUSH-LATCH STYLES — Hook type couplings make quick connections that cannot accidentally be disconnected.

SEE OUR CATALOG IN SWEET'S FILE for PRODUCT DESIGNERS

MINES Neoprene rubber Connectors will solve your connector problems too. For a quotation give us the customary electrical characteristics of your needs!

INDUSTRIAL DIVISION OF

MINES EQUIPMENT COMPANY

4257 CLAYTON AVE. — MINES — ST. LOUIS 10, MO.

Publication Service...

(1) Battery Handbook

A major technical contribution to battery purchasers, users, and maintenance men, is available in the form of a new 40-page pocket-size handbook of instructions and engineering data on the care of motive-power batteries. The handbook is divided into four sections, care and operation; maintenance and repairs; parts; and technical data. It is prefaced by two double-page spreads giving exploded views of the tape-insulated and mat-insulated types of batteries currently so widely used. Each part of the battery is clearly shown in relation to the others, and is keyed to descriptive text and instructions which follow. The care and operation section of the handbook gives instructions for receiving, placing in service, operating, maintaining and charging the storage battery. Ten pages, eleven photographs, and one chart are included in the maintenance and repair section. Illustrations and text give complete instructions on removing intercell connectors, cutting the sealing compound holding the covers of cells in place, removing the covers, removing cell elements, installing cell elements into a new cell jar, pouring compound to seal cell covers in place, and installing cell connectors. The parts section of the handbook not only lists battery parts, but catalogs battery tools for maintaining and repairing batteries and gives illustrations, line drawings, tables, and instructions on how correctly to order battery parts. The technical data section includes 8 charts of two general types. The eight charts give data for batteries having from 9 to 41 plates per cell for 8 different battery models. Gould Storage Battery Corp.

(2) Acidproof Cement

A six page bulletin, describing two acidproof products and picturing actual applications in the field, is available. These products have many uses in the steel industry in the construction of acid pickling tanks, pits, vats, sewers, floors, foundations and stacks. Sauereisen Cements Co.

(3) Diesel Locomotive Crane

A new catalog devoted to a 25 ton diesel locomotive crane is now available. The catalog illustrates the crane in action in magnet, bucket and hook work. Many photographs of the important mechanical features are also included. (600-L-5) American Hoist & Derrick Co.

You Can Obtain...

... any of the bulletins reviewed in the Publication Service of the IRON AND STEEL ENGINEER without obligation or cost. Simply circle the desired item numbers on one of the prepaid postal cards and mail. The requests will be forwarded to the manufacturers involved who will send the bulletins to you.

(4) Case Histories on Speed Reducers

Four years ago "Speedaire" was introduced as a new and radically different worm gear speed reducer. It promised to give "More Horsepower per Dollar." Welcomed by worm gear drive users, this fan-cooled unit has proved immensely popular. Four years of experience have fully borne out the claims made for it and demonstrated that it saves space, weight, and money. A bulletin is available that presents several "case histories" of typical installations — showing the facts and figures on actual savings realized by customers. Cleveland Worm & Gear Co.

(5) Synchronous Generators

A bulletin on high-speed, "Fabri-Steel," synchronous generators has just been released. Packed with many illustrations and descriptive copy, the four-page folder concisely tells about construction features of this newly designed generator. The generator is high-speed for belt drive or direct connection to diesel engine or geared to steam engine. (PB 2400-1). Elliott Co.

(6) Refractory Castables, Plastics and Mortars

Publication is announced of a new booklet on refractory castables, plastics and mortars. This comprehensive combined bulletin on a wide range of important refractory materials describes the products, outlines their characteristics, and indicates typical applications. Many of the products are suitable for temperature as high as 3000 F, and one, "Kromecast," for as high as 3100 F. Illustrated with photographs and tables of properties and required quantities, this 18-page bulletin will be helpful to operators of all types of industrial furnaces. The booklet contains a complete section on refractory castables, including the new high temperatures materials which are designed primarily to reduce cost of furnace construction and maintenance. Detailed notes on the application of each product are furnished with a practical table of materials and typical uses. These, with an analysis of properties of refractory castables, are also included as an aid in proper selection for specific needs. Data is given on B & W Refractory Plastics, what they are and when they should be used. Refractory mortars are thoroughly reviewed. (R-22). Babcock & Wilcox Co.

(7) Dust Control

An eight page bulletin is available that will help you visualize dust control equipment for your plant. The photographs show a few of the many ways in which a dust filter may be installed for the collection of a great variety of dust and for the disposal of the dust in various ways. These dust filters are used very extensively for the suppression and collection of industrial dusts, resulting in improved working conditions, cleaner plants and cleaner products, and in many cases the saving of valuable materials in considerable quantities. (D-491). W. W. Sly Manufacturing Co.

(8) Silica Cement

Recently published is an illus-

trated 6-page bulletin describing "Tayco-40," high temperature silica cement. The bulletin gives a complete description of the properties of the cement and its application for bonding silica and superduty silica refractories used in the construction of glass melting, open-hearth and electric arc melting furnaces. (507). Charles Taylor Sons Co.

(9) Magnetic Induction Drive

A bulletin is available describing the new "Dynatork Drive." Installed on a gas-powered "Utilitruc" fork-lift truck of 6000-lb capacity, the "Dynatork Drive" gives an astonishing demonstration of smooth, quiet, efficient transmission of power. The bulletin discusses the simplicity of the "Dynatork" principle and the construction of the unit. Power from the truck's engine is transmitted by means of magnetic induction. Two magnetic coils are mounted within the flywheel and are surrounded by magnetic poles. They rotate with the flywheel and are the driving members — one coil for "Forward," and the other for "Reverse." Two rotors attached to a special forward-and-reverse constant-mesh gearing, are the driven members. The magnetic inductive force is applied through an air gap and as a result there is no metal-to-metal contact between driving and driven members. Clark Equipment Co.

(10) Flat Spray Nozzles

Just reprinted and revised is a bulletin describing Rex flat spray nozzles. The bulletin illustrates these nozzles in service where water or liquid chemicals are used in cleaning, cooling, washing, and descaling operations. They are made in a variety of sizes and from a variety of materials. This bulletin besides illustrating and describing these nozzles and their uses gives tabular information concerning their discharge in gallons per minute, dimensions, materials, sizes and prices. (48-38). Chain Belt Co.

(11) Lubricated Plug Valve

Publication of the first edition of a new lubricated plug valve catalog is announced. Consisting of 16 pages, fully illustrated, and amply provided with dimensional drawings, tables, and descriptive matter, the new catalog covers the complete line of Porter lubricated plug valves. A feature of the catalog is a full-page cross-section view of the valve which, with the accompanying explanation, gives a remarkably clear description of the valve's advantages. The tables contain, in addition to dimensions and list prices, all pertinent data, such as size of lubricant stick, size of adaptor for pressure-gun lubrication, size of wrench and locking device, and weight of the valve. The line of lubricated plug valves includes all standard pipe sizes from 1 in. to 12 in. The valve is offered in semi steel for working pressures of 175, 200, and 500 psi, and in steel and 316 stainless steel for working pressures of 150 and 300 psi. (48-V). H. K. Porter Co., Inc.

(12) Cost Cutting Materials Handling

Recognizing, with the ever-widening application of electric industrial trucks to production cost-cutting, user preference for (1) sit-down truck operation, (2) low mast heights with high free-lifts, and (3) the desirability of using truck attachments which are hydraulically operated, a whole new line of electric trucks, with exclusive two-stage hydraulic lifting by means of the ram-within-a-ram principle, is announced in a bulletin that is available. The bulletin describes the first available series of "Lift King" electric trucks, which has a "free-lift" of 66 in. permitting the truck to tier goods inside freight cars and street trucks, and in low headroom spaces. This model can reach 130 in. from the floor, can carry up to 6,000 lb, and has an overall collapsed height of only 83 in. A second series described has an overall collapsed height of barely 68 in., a free lift of 51 in. and a total reach of 100 in. (5151). Yale and Towne Manufacturing Co.

(13) Self-Propelled Cranes

A new 16-page bulletin entitled "Self-Propelled Cranes," which illustrates 48 of the various applications of self-propelled cranes for industrial material handling and construction operations, has been released. Lorain Self-Propelled Cranes are single-engine, one-man operated cranes, with four speeds in either direction. The crane is capable of traveling to all parts of the job at speeds up to 7 mph. A selection of wide-track and standard width machines are offered in the self-propelled models. This new bulletin illustrates many fields in which self-propelled machines are now serving. (1451518). Thew Shovel Co.

(14) Mill Type Cranes

A folder is available describing mill type cranes as you would build them. Bridge design ideally suited to steel mill applications is illustrated and described. Also included is a description of trolleys designed to function under a severe over-load. Various types of cranes and trolleys are illustrated. A diagram is included showing a typical heavy-duty mill trolley, showing main hoist with outside jackshaft brake and Youngstown type limit stops. Victor R. Browning & Co., Inc.

(15) Induction Motors

Just released is a bulletin on new two-pole, 250-3500 hp, Fabri-steel induction motors. These motors may be of the drip-proof, splash-proof, enclosed, self or separately, ventilated types. Sleeve bearings are ring-oiled for motors 900 hp and smaller, pressure-lubricated for motors 100 hp and larger. Twenty-three illustrations and concise wording explain details of construction. (PB7000-1). Elliott Co.

(16) ASTM Standards Index

"Index to ASTM Standards," December, 1947 has just been issued. This publication issued in May, 1948, is really an adjunct to the book of standards (6600 pages) and the 1947 Supplements (1800 pages), and enables any of the some 1500 standard specifications and tests in the volumes to be located readily. The Index is also of service to those who wish to determine whether ASTM has issued standard specifications, test methods, or definitions covering a particular engineering material or subject. All items are listed in the Index under appropriate key-words according to the particular subjects they cover. As a convenience a list is given of the specifications and tests in numeric sequence of their serial designations. Copies of

the 240-page publication are furnished without charge. American Society for Testing Materials.

(17) Anti-Corrosion Strap Selector

As part of its program of educating maintenance and production men in the proper selection of strapping for various conditions, an anti-corrosion strap selector is available to you. In operating this interesting and handy device, the user simply dials an arrow so that the arrow-head points to the type of chemical condition, atmospheric environment, soil, water or gas fumes to which the strapping will be exposed. An opening in the butt section of the arrow then automatically reveals which metals will, and which will not, give good service under the specified condition. The selector is designed so that practically every type of service condition to which metal strapping may be exposed is covered. As a result, the user of the selector finds it a simple matter to pick the right strap for his needs from the seven different varieties of metals in which steelbinder strapping is available. The selector is a dual purpose device in that its opposite side is a handy Calculator which enables the user to determine with slide rule precision the length and weight of steel or aluminum strapping required for any given binding operation. A. J. Gerrard & Co.

(18) Alloy Iron Rolls

A bulletin is available on red circle alloy iron chilled steel mill rolls. Applications and characteristics of these rolls are given in this bulletin. The chill and grain are described. Illustrations of various mill stands, shears and levelers manufactured by this company are given together with a complete list of other products. The 1948 price schedule for iron and alloy iron rolls is given with the shipping weights and machining prices per roll. Hyde Park Foundry & Machine Co.

(19) Centrifugal Pumps

A bulletin is available describing an augmented line of horizontal centrifugal pumps for general purpose pumping of water and alkaline fluids at temperatures up to 300 F. These pumps are single stage, double suction, split case design and are available from 1¼ in. through 48 in. All types of drives may be employed including direct-connected electric motor, diesel, natural gas and gasoline engines, belted drives, steam turbine and combinations. The bulletin is complete with schematic and sectional drawings, application photographs, and tabulated material. (B-1300). Peerless Pump Division, Food Machinery and Chemical Corp.

(20) Steam Boilers and Generators

Three bulletins on boilers are available to you. The first bulletin describes the various boilers manufactured by this company. The second one describes four drum water tube boilers and includes dimensions, sectional drawings and operational data with typical performance curves. The third bulletin is entitled "Titusville Steam Generators." This 10-page bulletin embodies several unusual features designed to assist engineers whose job it is to specify boilers. In conjunction with engineering drawings of standard and specially designed boilers, the bulletin includes charts with performance ratings, specification tables and typical installation photographs. A boiler setting diagram is enlarged on a double-page spread so that it can be readily used by engineers for writing their own specifications. (3225-A, B-3250A and Boiler Family). Titusville Iron Works Division, Struthers Wells.

(21) Open Gear Lubrication

A technical article is available entitled "Lubricating Open Gears." This article discusses speed, vibration, shock, reversal, intermittent action, exposure to the elements and contamination with metallics, which are among the severe operating conditions which efficient open gear lubricants are meeting. Included in the discussion are the physical properties required, the selection of the correct lubrication, improvements in test procedure and recent accomplishments. Brooks Oil Co.

(22) Rough Grinding

A 52-page book on rough grinding is available to you. This book discusses abrasives and bonds, wheel selection, floorstand grinding, portable grinding, finishing welds, cut-off wheels, rubbing blocks, wheel evaluation and grinding costs. Included are tables on speeds and wheel shapes. (1405). Norton Co.

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52	BEDFORD FOUNDRY AND MACHINE CO.		Catalog on Cranes of any Span or Lift
53	BLOOM ENGINEERING CO., INC.	BULLETIN 4100	Time Cycle Reversal System for Open Hearth Furnaces
54	BROWNING AND CO., VICTOR R.	BULLETIN "S"	"Cranes Built as You Yourself Would Build Them"
55	BUFFALO FORGE CO.		Bulletin on Combination Slitting Shears, Punching and Bar Cutters
56	CROCKER-WHEELER ELECTRIC MFG. CO.		Booklet entitled, "It's Different—It's a Dollar-Saver." Tells why the Sealed-power Motor will save money for you
57	CUTLER-HAMMER, INC.	BULLETIN 10337 BULLETIN 13522	Pneumatic Timer Electronic Timer
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59	FARREL-BIRMINGHAM CO., INC.	BULLETIN 115	Heavy Duty Roll Grinders
60	FARVAL CORP.	BULLETIN 25	Automatic Centralized Lubrication Systems
61	FLUOR CORP., LTD.		Booklet on Cooling Towers Entitled "Cold Water Cheaper"
62	GENERAL ELECTRIC CO., APPARATUS DEPT.	BULLETIN GEA 4654	Technical Data on MD600 Mill Motors
63	GENERAL ELECTRIC CO., CONSTRUCTION MATERIALS DEPT.		Booklet Entitled "Deltabeston Magnet Wire Booklet." Includes Selection Chart
64	GLEASON AND CO., J. L.	CATALOG 548	Cable and Hose Reels
65	HUNT AND SON, INC., C. B.		Catalog on "Quick-as-Wink" Lever Operated Hydraulic Valves
66	I-T-E- CIRCUIT BREAKER CO.	CATALOG 2202	Automatic Reclosing Circuit Breaker
67	KOPPERS CO., INC., FAST'S COUPLING DEPT.		Detailed Information on Fast's Couplings
68	LINCOLN ENGINEERING CO.	CATALOG 63 and BULLETIN 801	Lincoln Lubricating Equipment
69	LINTERN CORP.	BULLETIN AC 349	Lintern Crane Cab Conditioners
70	MARVEL ENGINEERING CO.	CATALOG 103	Synclinal Filters for Protection of Hydraulic Equipment
71	OKONITE CO.	BULLETIN IS-1037	Advantages, Dimensions and Other Data on Okolite-Okoprene Cables
72	POOLE FOUNDRY AND MACHINE CO.		Catalog Containing Full Description and Engineering Data on Flexible Couplings
73	RELIANCE ELECTRIC AND ENGINEERING CO.	BULLETIN C-404	Bulletin on Gear Motors, also a Bulletin on Precision-Built A-C Motors
74	WAGNER ELECTRIC CORP.	BULLETIN IU-40	Wagner Industrial Brakes
75	WARE FUSE CORP.		Circular on "Hi-Lag" Renewable Fuses
76	JOHNS MANVILLE	CHART IN-6D	Thermal Insulation Chart

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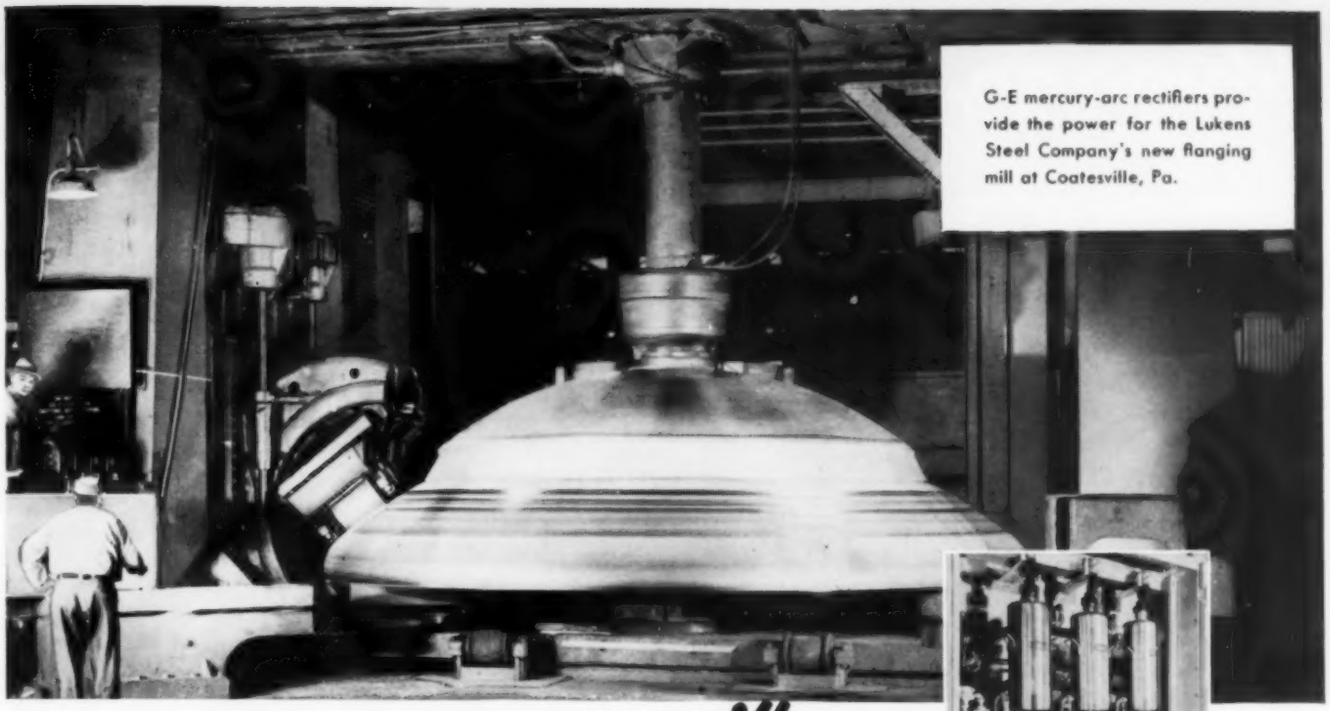


G-E mercury-arc rectifiers provide the power for the Lukens Steel Company's new flanging mill at Coatesville, Pa.

Keeps flanging mill on the go!

G-E mercury-arc rectifier in new electronic drive also cuts installation, power, and maintenance costs

Here it is— the first steel-mill application of the sealed-ignitron mercury-arc rectifier as a practical source of variable-voltage power. Outstanding feature of a new General Electric drive for the Lukens Steel Company's 276-inch hot flanging mill, it provides smooth, stepless speed adjustment over the entire speed range, plus these added advantages:

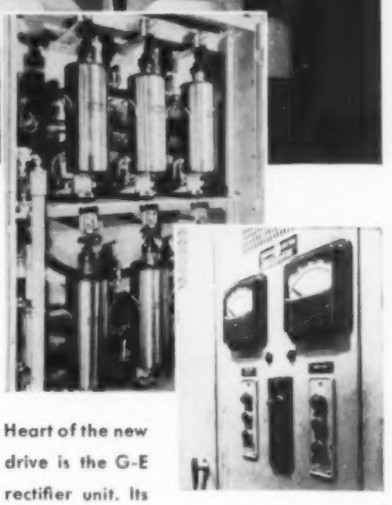
Shorter installation time A rectifier equipment offers no vibration problems, does not need heavy foundations. It can be split up into sections to suit space limitations.

Savings in power costs Because of the high efficiency and low no-load losses of these rectifiers, especially important during the mill's idling time, new power savings are effected.

Less maintenance Maintenance costs on this mill are less because the rectifier equipment does not have to be blown out, and has no commutators, slip rings, or brushes.

Improved service continuity Long-life rectifier tubes can be replaced quickly and easily, when necessary. Carrying a three-year warranty, they have an average life of four to five years.

G-E mercury-arc rectifiers can reduce costs in many other steel mill operations as well. It's worth your while to check their possibilities. *Apparatus Dept., General Electric Company, Schenectady 5, New York.*



Heart of the new drive is the G-E rectifier unit. Its six sealed ignitrons (**above**) are housed in a dead front, metal-enclosed rectifier control cubicle (**right**) and supply variable-voltage power to the G-E 350-hp motor, Type MD, which drives the flanging mill's main spindle.

WHAT CAN IT SAVE FOR YOU?

A G-E steel mill specialist will gladly show you where and how a mercury-arc rectifier can help cut costs in your mill. Call him at your nearest G-E office.

GENERAL ELECTRIC

659-63

MERCURY-ARC RECTIFIERS

for Steel Mills

Personnel News...

Dr. G. V. Slottman has been appointed director of research and engineering for Air Reduction Co., New York, N. Y. Dr. Slottman, who joined Air Reduction in 1934, served as manager, technical sales division and, on January 1st, 1948 was appointed technical assistant to the vice president in charge of sales, a position he held until his recent appointment. A native New Yorker, Dr. Slottman was graduated from Massachusetts Institute of Technology in 1925. In 1927, he received his Ph.D. from the University of Berlin and returned to M.I.T. as a professor of chemical engineering. From 1930 until he joined Air Reduction, Dr. Slottman served as chief combustion engineer and iron works manager for the United Steel Companies, Ltd., Sheffield, England.

T. W. Plante, formerly superintendent of blast furnaces at Jones & Laughlin Steel Corp.'s Eliza works at Pittsburgh, Pa., has accepted a position with the Pacific Steel Co. of Chile. At Concepcion, Chile, Mr. Plante will be superintendent in charge of blast furnace operations and raw materials. He will work in the New York office of Pacific Steel until early spring when he will go to Chile to make his home.

R. G. Neilson has been named general manager of production and manufacturing for Mackintosh-Hemphill Co., Pittsburgh and Midland, Pa. Mr. Neilson will supervise production and manufacturing operations in the company's plant at Midland, Pa. and also in the Garrison plant on Pittsburgh's South Side. Starting as a roll turner under his father, Mr. Neilson has spent almost his entire business career either making or selling iron and steel industrial rolls. Prior to joining Mackintosh-Hemphill Co. in 1933, he worked on rolls in the plants of such companies as United Engineering, Mesta Machine, Crucible Steel and for four years he was in charge of the Timken Roller Bearing Co. roll shop. From 1933 to 1935, and from 1947 to date, Mr. Neilson was in charge of the Mackintosh-Hemphill roll shop in the Garrison Plant. During the intervening years he had been transferred to the sales department and placed in charge of sales in New York City and vicinity.

Professor Thomas K. Sherwood, dean of engineering of Massachusetts Institute of Technology, and **Dr. Bruce S. Old** of the staff of Arthur D. Little, Inc., were today elected to the board of directors of Arthur D. Little, Inc., Cambridge, Mass., research and engineering organization. **R. C. Griffin** retired as director and as assistant secretary under the company's regular retirement plan.

Vernon O. Droege of Gary, Ind., has joined Youngstown Sheet and Tube Co. as division engineer in the industrial engineering department. Mr. Droege is a native of LaPorte, Ind., and a graduate of LaPorte High School. After receiving his B.S. degree in industrial engineering at Purdue, he held positions of industrial engineer for Carnegie-Illinois Steel Corp.'s sheet and tin mill at Gary, assistant plant industrial engineer for Continental Foundry & Machine Co., East Chicago, and consulting engineer with Albert Ramond & Associations, Inc., of Chicago.

Lewis E. Zender, member of the American Steel & Wire Co. public relations staff for 11 years, has been appointed the company's public relations director. He succeeds **William I. Ong,** who has been named assistant to the president of the company. In his new position, Mr. Zender will direct the company's public relations activity, as well as Ohio-Michigan district public relations activities for other U. S. Steel subsidiaries.

Robert W. Moffett, general manager of fabrication of Lukens Steel Co., Coatesville, Pa., since February 25, 1946, retired February 1. **Raymond M. Dennis,** who has been assistant to the general manager of fabrication at by-products division, has been named as manager of fabrication, by-products and **Frank C. Kardevan,** who has been assistant to the general manager of fabrication of Lukenweld, has been named manager of fabrication, Lukenweld division.

C. J. Forbes, formerly assistant to director of industrial relations, was placed in charge of a newly-established research division in the industrial relations de-

DR. G. V. SLOTTMAN

T. W. PLANTE

R. G. NEILSON

partment of American Steel & Wire Co., Cleveland, Ohio. Mr. Forbes has been associated with American Steel & Wire Co. since his graduation from Harvard University in 1936.

R. S. Bradley has been promoted to head a newly created division as director of research and engineering at the A. P. Green Fire Brick Company in Mexico, Mo. This new division is composed of three sections: research engineering, headed by **A. R. Lesar;** industrial engineering, by **W. D. Clark;** and plant engineering, by **J. C. Potts.**

Louis C. Edgar, Jr., has taken over his duties as president of the E. W. Bliss Co. Mr. Edgar, who at 38 is the youngest president since Eliphalet W. Bliss founded the company 90 years ago, will make his headquarters at the Toledo, Ohio, works. A mechanical engineering graduate of Cornell, Mr. Edgar was asso-

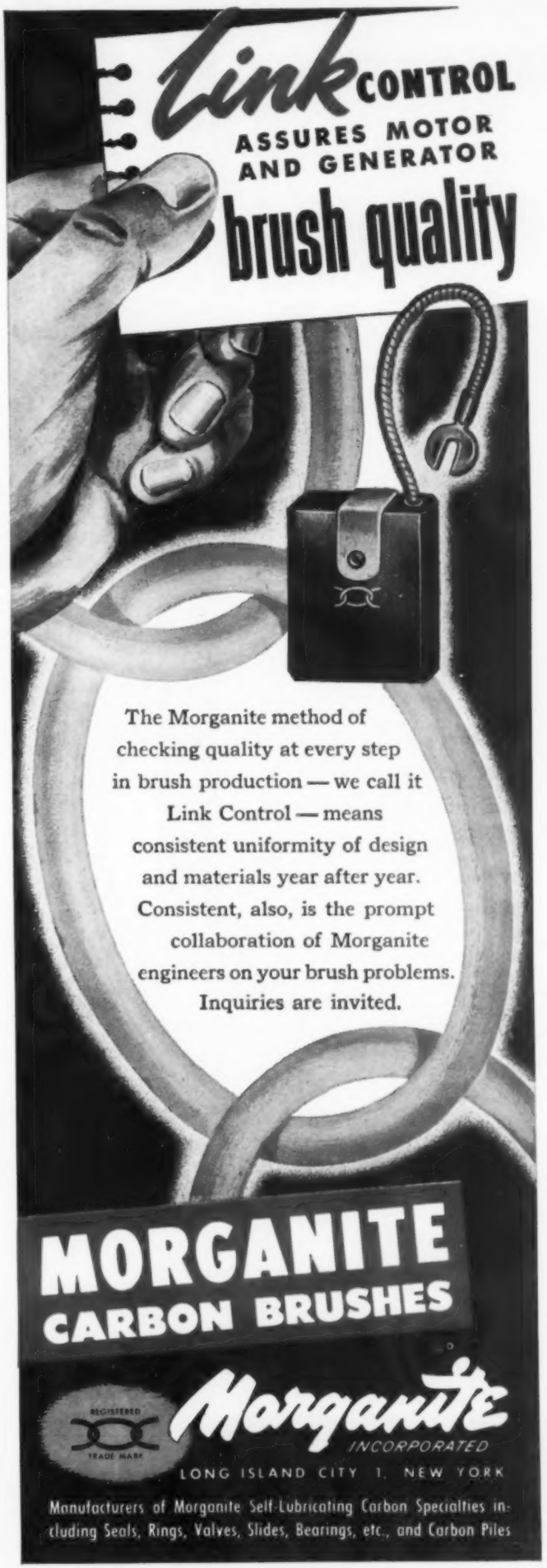
LOUIS C. EDGAR, JR.

ciated with the Babcock & Wilcox Co. in the manufacture of penstocks for the Boulder Dam at Boulder City, Nev., from 1933-36. From 1936 to 1946 he was with the Blaw-Knox Co. as a service and design engineer and finally as general manager of its Martins Ferry Division in Ohio. He became president of the H. & B. American Machine Co. in 1946 and served in that capacity until his recent election to the presidency of the Bliss Co.

Frank T. Sisco, director of alloys of iron research, was appointed technical director of the Engineering Foundation. The Engineering Foundation, joint research agency of American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers, and American Institute of Electrical Engineers, sponsors and supports fundamental research in all fields of engineering.

Wallace F. Schott was appointed manager of the Lee Wilson Construction Co. of Cleveland, Ohio. Mr. Schott was graduated from Ohio Northern University in electrical engineering. He took post graduate work at New York University and University of London, England, following 2½ years in the United States Engineer Corps in France during World War I.

George W. Nelson was named general superintendent of Lee Wilson Construction Co. Mr. Nelson, during the past 15 years, was furnace erection superintendent for Lee Wilson Engineering Co., Inc.


Link CONTROL
ASSURES MOTOR AND GENERATOR
brush quality
The Morganite method of checking quality at every step in brush production — we call it Link Control — means consistent uniformity of design and materials year after year. Consistent, also, is the prompt collaboration of Morganite engineers on your brush problems. Inquiries are invited.
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CARBON BRUSHES
REGISTERED TRADE MARK
Morganite INCORPORATED
LONG ISLAND CITY 1, NEW YORK
Manufacturers of Morganite Self-Lubricating Carbon Specialties including Seals, Rings, Valves, Slides, Bearings, etc., and Carbon Piles

DE LAVAL VERTICAL DRIVE REDUCERS

A complete line of De Laval vertical speed reducers, in both single and double reductions, is available for driving agitators, mixers, and many other types of vertical shaft equipment.

If vertical drives are your problem, consult De Laval.

*This single reduction De Laval Worm Gear Reducer is available with many standard gear ratios and is but one of the 93 sizes and types of standard De Laval Worm Gear Speed Reducers.

Worm Gear Division

DE LAVAL

De Laval Steam Turbine Co., Trenton 2, N. J.

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS • CENTRIFUGAL PUMPS
CENTRIFUGAL BLOWERS AND COMPRESSORS • IMO OIL PUMPS

Continuing a policy of providing maximum service to the instrumentation and control fields, Bailey Meter Co., Cleveland, Ohio, has announced another large expansion of its staff of field engineers. Twenty-seven men, all engineering graduates of universities or technical schools, have completed the company's special training program, a requisite for all Bailey Meter engineers, and eleven are now being assigned as follows: **R. E. Byers** to the St. Louis office in the Chouteau Trust Bldg., **N. P. Campbell** to the San Francisco office in the Sharon Bldg., **G. F. Fitzpatrick** to the Denver office at 1506 Kearney St., **R. A. Homan** to the Pittsburgh office in the Oliver Bldg., **T. A. Melton** to the Charlotte office in the Independence Bldg., **W. G. Thiemann** to the New York office at 30 Church St., **J. F. Kontz** to the Cleveland district office, **G. H. West** to the Atlanta office at 184 Pryor St. N.W., **N. S. Wilson** to the Philadelphia office in the City Centre Bldg., **M. G. Johnson** to the Houston office, **R. P. Marche** to the Chicago office in the Monadnock Bldg., **R. E. Ellis** and **W. H. Robbins** have been assigned to the engineering department, **R. E. Hartman** and **R. E. Paulson** to the sales department, **A. L. Wade** to the patent department and **F. S. Holby** to the research department in Cleveland.

S. J. Mergenhagen has been appointed assistant sales manager of Heppenstall Co., Pittsburgh, Pa., and **R. H. Musser** succeeds him as district sales representative in Philadelphia. The appointments are effective April 5. Mr. Mergenhagen joined Heppenstall Co. in July, 1945 after eight years in Erie, Pa., as district

S. J. MERGENHAGEN

sales manager of Brace-Mueller-Huntley, Inc., sales agents for Heppenstall. After several months in the Pittsburgh sales office, Mr. Mergenhagen was named to the Philadelphia territory in February, 1946. Mr. Musser has been an employee of Heppenstall Co. since 1928.

Charles V. Masterson, Jr. has been appointed superintendent of industrial relations of Carnegie-Illinois Steel Corp.'s Gary, Ind., sheet and tin mill. Mr. Masterson, a native of Brooklyn, N. Y., started his career with Carnegie-Illinois at the Gary sheet and tin mill as an industrial engineer in June, 1940, after receiving his master's degree from New York university. He progressed through various industrial relations ca-

pacities at the sheet and tin mill and in the Chicago office until he was appointed assistant superintendent of industrial relations at the mill in September, 1947, the job he holds at the present time.

William P. Jones was named supervisor of education and training for Carnegie-Illinois Steel Corp., Pittsburgh, Pa. Mr. Jones also started his career with Carnegie-Illinois as an industrial engineer at the Gary sheet and tin mill. After graduation from the University of Michigan with a B.S. degree in aeronautical engineering, Mr. Jones entered the steel business in 1936. This will be his second assignment with the company in Pittsburgh. He had spent three years there prior to being appointed superintendent of industrial relations at the sheet and tin mill in September, 1947.

Raymond B. Seymour, formerly chief chemist for Atlas Mineral Products Co., Mertztown, Pa., has returned as executive vice president and general manager.

Wilson W. Wheeler was named sales manager for Askania Regulator Co., Chicago, Ill. Mr. Wheeler first joined Askania in 1941 in the sales engineering department. In 1945 he became head of that department.

WILSON W. WHEELER

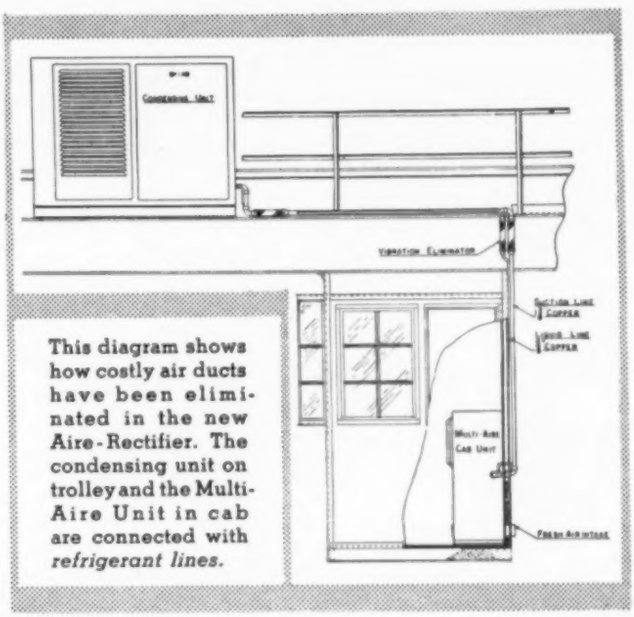
Prior to his association with Askania, Mr. Wheeler was engaged as a mechanical engineering consultant in Cincinnati. He is a graduate of Purdue University, class of 1932.

Albert F. Metz was elected president and general manager of Okonite Co., Passaic, N. J. Mr. Metz, who was previously vice president and treasurer of the company, replaced **Frank C. Jones,** who died January 20. Mr. Metz joined Okonite Co. in 1919 as accountant, following a previous career as assistant to the comptroller of Famous Players-Lasky Corp., and as disbursing officer and auditor for the United States Shipping Board during World War I. During his thirty years with Okonite Co. he also served as comptroller and treasurer.

Donald R. Stevens was elected executive vice president of Okonite Co., Passaic, N. J. Mr. Stevens joined the organization in 1921 as superintendent and became vice president and works manager in charge of its three plants.

Austin J. Lease of Struthers, Ohio, has been appointed assistant superintendent of the cold drawn bar

New LINTERN AIRE-RECTIFIER Saves 6 Ways



This diagram shows how costly air ducts have been eliminated in the new Aire-Rectifier. The condensing unit on trolley and the Multi-Aire Unit in cab are connected with *refrigerant lines.*

This diagram shows how costly air ducts have been eliminated in the new Aire-Rectifier. The condensing unit on trolley and the Multi-Aire Unit in cab are connected with *refrigerant lines.*

These six savings result: (1) Reduced engineering costs. (2) Elimination of expensive, efficiency-reducing air ducts. (3) Higher cooling efficiency in the cab. (4) Greater flexibility in location of all equipment. (5) Lengthened life of operating equipment because of protection from excessive radiant heat and greater accessibility for service. (6) Location of Aire-Rectifier on existing cranes without moving any equipment.

MULTI-AIRE CAB UNIT

This includes a cooling coil (evaporator) with copper drip pan, electric heat for winter use, with screen type and activated carbon filters — all encased in a heavy gauge steel cabinet for steel mill service. Both the heating and cooling phases are controlled by automatic thermostats. Harmful dust and dangerous gases are removed by the filters, providing the desired health protection for operators.

Ask for fully illustrated Bulletin AC-349.

THE LINTERN CORPORATION

60 Lincoln Avenue Berea, Ohio

Save steel!
Save acid!
Save money!

USE Oakite Pickle Control No. 3 to inhibit hot sulphuric-acid pickling baths! Use Oakite Pickle Control No. 4 to inhibit hydrochloric-acid pickling baths!

Oakite Pickle Controls minimize the attack on steel without retarding the action on scale or rust. They prevent waste of acid after scale and rust have been dissolved. They have saved some customers as much as 19 cents per ton on steel-pickling operations.

FREE For complete information about Oakite Pickle Controls, phone the Oakite Technical Service Representative in your city or write to Oakite Products, Inc., 19 Thames St., New York 6, N. Y.

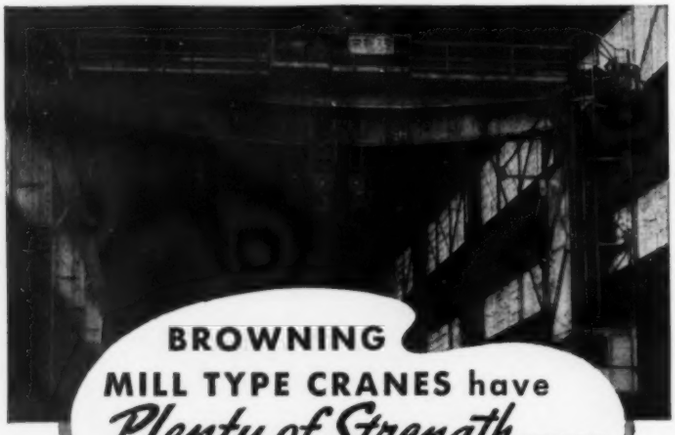
OAKITE 1909 1949 40th ANNIVERSARY YEAR

OAKITE

REG. U. S. PAT. OFF.

INDUSTRIAL CLEANING MATERIALS • METHODS • SERVICE

Technical Service Representatives Located in Principal Cities of United States and Canada



BROWNING MILL TYPE CRANES have *Plenty of Strength* WHERE STRENGTH IS NEEDED!

Browning Mill Type Cranes are built in accordance with A. I. S. E. specifications. They incorporate the types of motors and controls on which your mill or industry has standardized. This flexibility adapts your VRB crane *perfectly* to your needs. Only the finest materials are employed. Browning heavy duty cranes meet the most rigid demands and satisfy the most critical users. Our design, placing plenty of strength wherever needed, is the outgrowth of 48 years' experience in the crane industry.

"Built as you yourself would build them"

Write for our Bulletin "S".

VRB

VICTOR R. BROWNING & COMPANY, Inc.
BOX 309, WILLOUGHBY (CLEVELAND), OHIO
Designers and Builders of Electric Overhead Traveling Cranes and Hoists and Electric Revolving Cranes

department at the Brier Hill plant of Youngstown Sheet and Tube Co.

T. F. Rose, Cincinnati branch manager of Timken Roller Bearing Co.'s service sales division, has become manager of Timken Roller Bearing Service and Sales, Ltd., Toronto, Ontario, Canadian subsidiary of the Canton, Ohio company.

Sevard T. Salvage, assistant district manager of industrial bearing sales in the Cleveland office, has been made sales promotion manager of Timken Roller Bearing Co., with headquarters in Canton, Ohio.

E. M. Slonaker, district sales manager for the Willard Storage Battery Co. in Chicago, Ill., has been named to direct the company's related products division in Cleveland, Ohio.

C. R. Terry has now organized the Terry Machinery Co., Hanna Bldg., Cleveland, Ohio, a sales agency for metal working machinery. Mr. Terry, for the past six years has been manager of Cleveland and Pittsburgh offices for Hydraulic Press Manufacturing Co.

Dudley C. Jackson was appointed as distributor for Trabon Engineering Corp.'s line of centralized lubrication equipment in the Chicago area. Mr. Jackson has been associated with Trabon since 1935 in various capacities and for the past six years has been service manager. His office will be at 549 West Washington Boulevard, Chicago 6, Ill.

Howard C. Rodgers, a native of New Castle, Pa., has joined Youngstown Sheet and Tube Co. at East Chicago, Ind., as superintendent of the tin mill finishing department. Mr. Rodgers' training in tin finishing began at the age of 15 when he became a laborer in the New Castle works of the American Sheet and Tin Plate Co. He worked as a roll grinder, brannerman helper, poole mechanic and tin house clerk, advancing to unit foreman. Prior to coming here he was tin house and electrolytic superintendent for Tennessee Coal, Iron and Railroad Company at Birmingham, Ala.

Obituaries

A. E. Ruemmele, 59, chief engineer, Jay J. Seaver Engineers, Chicago, Ill., died January 30 of a heart attack.

Arthur S. Nichols, 48, vice president and sales manager of Illinois Clay Products Co. for more than 23 years, passed away February 18, 1949. He was born in Chicago and educated at the University of Illinois.

Henry J. Walters died February 6, 1949 in Los Angeles, Calif., after a long illness of several years. Mr. Walters was born July 14, 1873, and had worked for the Jones & Laughlin Steel Corp. for 56 years before he retired on December 31, 1944, having started in August, 1888 as pull-up boy on the No. 9 rolling mill assisting his father who was a roller at that time. He worked up through the ranks and was assistant superintendent of the electrical department at the Pittsburgh works at the time of his retirement. Mr. Walters was active in the electrification of the steel industry. He trimmed the first arc lamp installed at Jones & Laughlin, and was active in the development of the first electric crane put in service by that company.

Hugh Schuyler Robertson, vice president of Harbison-Walker Refractories, died February 21, while vacationing in Guatamala. Mr. Robertson, whose home was on Thorn Run Road, Coraopolis Heights, had been with Harbison-Walker Refractories Co. since 1916. At the time of his death he was a director and vice president of the firm. Born in Chillicothe, Ill., he was graduated from the University of Illinois, and during World War I, served in the Air Corps. Mr. Robertson began his career with Harbison-Walker as a sales correspondent and rapidly rose to top executive positions. After serving as manager of the basic sales and export division,

HUGH SCHUYLER ROBERTSON

he was appointed assistant general sales manager in 1933. In 1940 he was promoted to general sales manager, and was elected a director three years later. Last year he became vice president.

Harry S. Richardson, formerly control engineer with Electric Controller & Manufacturing Co., Cleveland, Ohio, died February 25, 1949 at Huron Road Hospital, Cleveland, Ohio. Born in Terre Haute, Ind., Mr. Richardson graduated from Rose Polytechnic In-

HARRY S. RICHARDSON

stitute in 1900, received his master's degree in 1902. After graduation and a 3 year period in engineering work with the War Department in Washington, he came to Cleveland in 1903 to join EC&M, with whom he was associated for 45 years before retiring last October.

CLEAN PIPES

mean greater efficiency

Keeping your pipes in condition to deliver maximum efficiency of performance means keeping them *clean* — and we can do that job for you easier and cheaper than you can do it for yourself. We have the specialized equipment, the experience and the trained personnel to clean, rehabilitate and maintain all types of pipes and piping systems.

Many leading industrial organizations use our services exclusively. May we tell you in detail about the benefits they receive—and that are available to you. Just write or call.

EASTERN PIPE MAINTENANCE COMPANY
716 CLARK BUILDING
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LOOK TO THE FUSE LEADER FOR PRODUCTION PROGRESS

WARE HI-LAG *Renewable* FUSES

Wide Double Contact Surfaces — Spring Tension Locking of Links

Expansion and contraction of metals during *Off* and *On* periods compress links. This fluctuation causes loose contacts and oxidation in other fuses, which finally result in excessive heating and unnecessary blows. WARE HI-LAG construction keeps contacts permanently tight, thus insuring low resistance and longer fuse life.

Write for Circular — APPROVED BY UNDERWRITERS LAB.

WARE FUSE CORPORATION
4460 W. LAKE ST. CHICAGO 24, ILL.

Announcing

The BLOOM TIME CYCLE REVERSAL SYSTEM for Open Hearth Furnaces

In this one compact cabinet are all the instruments, relays, timing devices you need for completely automatic reversal of firing of open hearth furnaces.

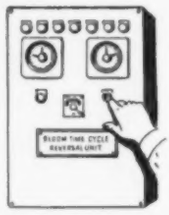
FACTORY-BUILT,

Easy to install. Field Wiring very simple.

COMPLETELY WIRED,

Automatic reversals made at predetermined intervals.

READY-TO-INSTALL

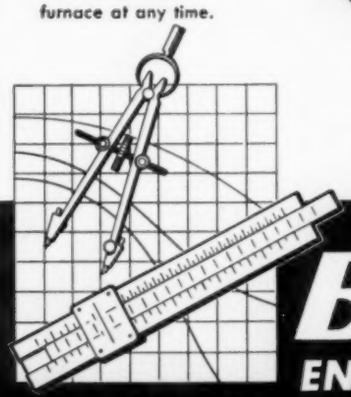


Push button reverses furnace at any time.

With this system, the average furnace can be reversed in 9 to 10 seconds!

Write

for bulletin describing this equipment, and showing how it meets all operating requirements. Ask for bulletin No. 4100.



BLOOM ENGINEERING CO., INC.

857 W. North Avenue Pittsburgh 12, Pa.

No WARP... or BUCKLE!

with P-G "FLOATING BOLT" CONSTRUCTION •••

End view of Standard Resistor Unit, with nuts and insulating washers removed, showing elongated holes in the end frame and illustrating the method used to support P-G Resistance Grids in the end frames.

"Floating Bolt" construction, as used in P-G Resistor assembly, provides space to allow the resistance grids to expand under heat. This feature automatically prevents *warp* or *buckle* since the grids are free to move within their maximum limits of expansion . . . Provision for expansion, resistance to corrosion, adequate ventilation, plus steel and mica as basic materials, assure you of longer trouble-free resistor service . . . Try P-G.

P-G

The Nonbreakable Steel Grid Resistor

THE POST-GLOVER ELECTRIC COMPANY

• ESTABLISHED 1892 •

221 WEST THIRD STREET, CINCINNATI 2, OHIO

INDUSTRY KEEPS ON *Pioneering*

When full details of these new developments are reported, one main point will deserve to stand out:

Industry continues to find process-improvements and to do so is willing to adopt radical means in supplanting customary methods.

In these new instances, the steel industry's *pioneering* is the dominant characteristic—the taking of calculated, voluntary risk in order to advance production practices and make new headway in producing quality product at lowest cost.

Methods for continuous bright-annealing of strip have been under investigation for years to establish production-line data and to develop desirable product characteristics while shortening annealing time from hours to seconds. During these studies, the first successful use of GRADIATION for high-speed, continuous fusion on an electrolytic tinplate line went into operation and gave results which contributed to development of the same gas-firing techniques for continuous bright-annealing. A bulletin, now available, called:

"CONTINOUS GAS-RADIANT FUSION
FOR ELECTROLYTIC TINNING"

is useful in providing background not only for the new 1200 fpm fusion line but also for the new method of in-line annealing by which gas-radiant heating achieves high heat-transfer rates with extremely precise cycle control.

SELAS CORPORATION OF AMERICA

NEW Gradiation DEVELOPMENTS GOING "ON THE LINE" THIS YEAR

CONTINUOUS, BRIGHT-ANNEALING OF STEEL STRIP

Short-cycle heating and cooling; gas firing; 20 tons/hr; 600-800 fpm; up to 36 inches strip width.

STRAIGHT-THROUGH, HIGH-TONNAGE BILLET HEATING

40 tons/hr; billets 3¼ to 5 inches diameter and up to 40 feet long; gas firing system heats from cold to 2300° F in 8 to 12 minutes depending on size.

IN-LINE FUSION OF ELECTROLYTIC TINPLATE

53 tons/hr; gas-fired; 1½ to 2 seconds to 470° F; 1200 fpm; up to 36 inches strip width.

For basic information on GRADIATION as applied for automatic, straight-through heating of bars, tubes and billets, two bulletins are available. The titles are:

"GAS HEATING SPEEDS SEAMLESS TUBE PRODUCTION"
"HIGH SPEED ANNEALING OF STAINLESS BARS AND TUBES"

Both deal with operating installations which, essentially, are prototypes for new, high-tonnage billet heating lines. Description includes—how gas-combustion techniques give high heat-transfer rates and improve product quality; how metal-temperature is employed to provide extremely precise heat-transfer control; how responsiveness of radiant heat combined with high temperature combustion products is integrated in automatic processing to speed production and create deep savings in fuel and handling costs.

Requests for bulletins may be sent either to Selas representatives or directly to main offices, as below.

PHILADELPHIA 34 PA

THE NAME Gradiation IS A SELAS TRADE NAME

Technically, the name GRADIATION implies radiation—high speed, high temperature, solar-like heat; it implies gradient—faster heating by exposing materials to superheat with precise control of heating rate; it implies gas-radiation—which protects the charge and is economical to apply.

Equipment News...

ELECTRONIC FILTER CLEANS COKE OVEN GAS

▲A new electronic gas filter is now available that will enable steel mills to thoroughly clean the coke oven gas that accrues as a by-product in the manufacture of coke. The installation of such tested and proven units on normalizing and other furnace operations will save mills thousands of dollars annually by eliminating clogged burners, jammed valves or regulators. In utilizing their own coke oven gas which has been thoroughly cleaned, mills will no longer have to depend on natural gas — which is in short supply — for their more exacting requirements.

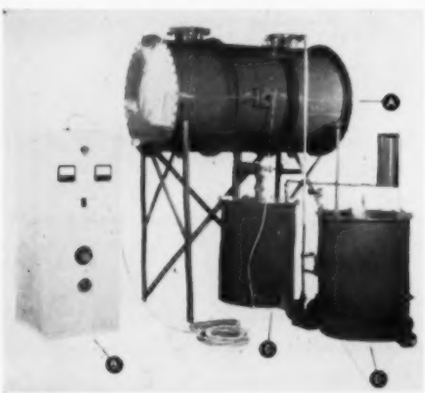
These filters are designed and manufactured by Trion, Inc., specialists in designing and manufacturing equipment for electrostatic cleaning and purifying of air and other gases.

The Trion electronic gas filter was designed to filter fuel gases where tar fog, coke dust, fly ash, lime dust or any combination of dirt cause trouble. It is a standard "package" consisting of a steel housing which contains the ionizing-collecting cell (A); an appropriate power pack supply (B); a solvent recirculating system (C); complete with solvent recovery still (D); and all necessary piping and electrical connections. The filter housing (38 in. in diameter by 60 in. long), which contains the ionizing cell, may be suspended for the piping or rested on a trestle. Rated capacity is 60,000 cf-hr at a cleaning efficiency of not less than 98 per cent by the "discoloration" method. The solvent washing and recovery system can be remotely located, or in cases where a battery of two or more filters are installed near each other, one washing system can be arranged to clean all filters in the battery. The power supply for each filter can either be fastened to the filter or be remotely located, whichever best suits the installation. Power requirements are 1 kw, either 110 volts or 220 volts, single phase, 60 cycle a-c. Operating costs have proven to be as low as $.001 per 1000 cu ft of gas cleaned, including power, solvent loss, and ordinary maintenance costs.

The fuel gas enters the top of the steel housing where, by means of patented turning vanes, it is passed uniformly through the ionizing-collecting cell. Tar fog, coke dust, fly ash, lime dust or any combination of dirt are ionized and collected on a series of steel plates. The plates of this cell have approximately 100 square feet of area on which dirt might collect, and that dirt could be allowed to build up to ⅛ in. at the deepest point without impairing the filter's operation. The frequency of cleaning is contingent entirely upon the "dirt loading" of the gas.

The cleaning process may be carried on without dismantling the unit. After the unit is de-energized, a pump is operated to cause the solvent in the reservoir to spray collecting plates for 20 to 30 minutes. This dirt laden solvent then drains back into the reservoir and can be used for several washing periods before it becomes necessary to reclaim it by distillation. The distilling process, for the recovery of the solvent, can be carried on at any time after the filter is put back into operation.

This unit will save money by cleaning coke oven gas for usage.



DUCTILE CAST IRON HAS CAST STEEL QUALITY

▲A new engineering material described as ductile cast iron, which combines the process advantages of gray cast iron, such as fluidity, castability and machinability, with the product advantages of cast steel, has been developed in the research laboratories of the development and research division of the International Nickel Co. Closing the gap between cast iron and cast steel, this material is characterized by a graphite structure in the form of spheroids, free from graphite in the flake form. Its excellent physical properties, particularly high elastic modulus, high yield strength and ductility, suggest its suitability for many applications hitherto considered beyond the scope of cast iron.

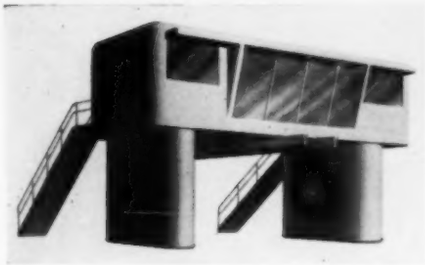
The production of this iron can be applied to common cast iron compositions melted in the cupola or in other kinds of furnaces, and is based on the introduction into the iron of a small but effective amount of magnesium or a magnesium-containing addition agent, such as nickel-magnesium alloy.

It is stated that the new material will take its place along with malleable iron, gray iron and cast steel in providing the needs of industry. It will be advantageous to overall foundry practices as the new techniques should increase the importance of the foundry industry among metal producing industries.

PANEL TYPE PULPITS ARE HEAT-RESISTANT

▲ Modern, streamlined mill pulpits are now being fabricated and installed by the Lee Wilson Construction Co., subsidiary of Lee Wilson Engineering Co., Inc. Because of many advantages offered, they are said to improve steel mill production substantially.

Of standard, insulated, panel-type design and streamlined throughout, these pulpits unquestionably have the "new look." In both design and engineering they reflect careful study of what is needed for greater efficiency in mill operation for rolling mills, blast furnaces, and in fact, wherever one-point control is required. The walls consist of heavy steel panels insulated to resist heat. The columns are shrouded, with all wiring concealed yet readily accessible through



The windows of these pulpits afford excellent operating view.

conveniently located doors and other openings. All corners — both inside and outside — are rounded.

The windows at the front are pitched for best possible operating view. Thick, shock-resisting glass is used to provide protection to operator against flying particles of steel or other objects.

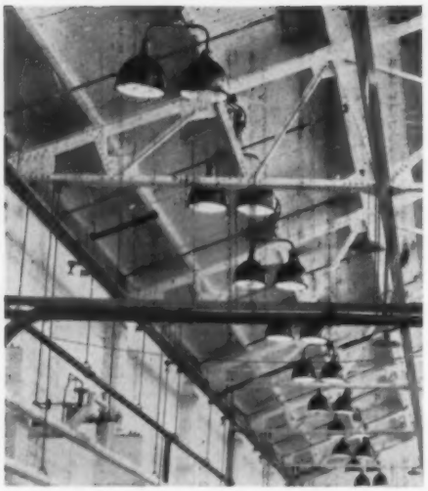
All features of these pulpits are as modern as their design — acoustical ceilings, non-slip floors, indirect lighting, a toilet so that operator need not leave pulpit. Desks — if needed — are installed with the units. And air conditioning is provided so that regardless of ambient temperature the pulpit can be kept at a comfortable 80 degrees with healthful, filtered air free from gases and fumes. Installation is said to result not only in substantially improved production but also in much better personnel relations.

The pulpits are supplied in several standard sizes and special sizes to order. Prefabricated, they are shipped in sections so that erection time is kept at a minimum. The job is handled from start to finish, including erection, by the Lee Wilson organization. This company also handles extensive furnace rebuilding and general contracting work.

VERSATILE HANGERS HAVE MANY FEATURES

▲ Designed for use with twin or triple unit combinations of mercury and incandescent luminaires, as well as for similar straight incandescent units, the Thompson Series 300 (three-way four-wire) disconnecting and lowering hanger facilitates maintenance and repair operations and permits quick changes (bulb sizes, color lenses, etc.) to meet varying requirements. This versatile hanger can be used in any combination of circuits within its rated capacity, such

"MULTICUT" "TUFCUT" "HOT WORK"
Wapakoneta
SHEAR BLADES
and ROTARY KNIVES
Any type or size blade of proper Alloy with correct hardness and temper for every type shearing machine and every kind of job.
Rx ENGINEERED TO THE JOB
Every Wapakoneta blade is made to exact specifications, designed for the particular job. Complete records with order number of each blade makes possible duplication of exact size and temper at any time.
The WAPAKONETA MACHINE CO.
Shear Blade Specialists Since 1891
Wapakoneta, Ohio



Electrical hazards are eliminated in these hangers.

as, two circuits three-wire leaving one pole blank, two circuits of two wires each, or three circuits of four wires with a common return.

With this arrangement, individual control can be used for each circuit, and a triple unit can be wired in various lighting combinations for temporary or permanent needs. This feature is important to institutions in which one room may have to serve, alternately, for assemblies, athletics, or dances, each use requiring a different lighting intensity.

In industrial applications where mercury lighting is used because of its intensity and low cost, the Series 300 Thompson hanger permits the use of incandescent lighting to soften the mercury lighting and to provide instantaneous light when the switch is closed.

The hangers feature positive latching, accurate repositioning, constant polarity, equalized contact pressure, and simple manual control through the lightweight chain or cable used to lower and raise the luminaire. In addition, the hangers eliminate all electrical hazards because lowered lighting fixture is "dead."

A complete hanger assembly consists of two members, upper and lower. Fixed upper member contains a pulley wheel for the operating chain or cable, a guide tube for repositioning, and two pair of cup-type contacts to which power lines are attached. Lower member, which supports luminaire, contains positioning stem, latching mechanism, and two pair of equalized ball-face contacts which complete circuits when fixture is raised.

BLISS REPLACEMENT SERVICE CENTRALIZED

▲ Users of the 200,000 Bliss-built presses in operation today can now secure replacement parts and service in record time as a result of a newly established program, the E. W. Bliss Co. announces.

Parts distribution has been centralized in two plants, Toledo, Ohio, and Hastings, Mich. Presses and other pressed metal machinery bearing the trademarks of Bliss, Toledo, Consolidated, Marquette, Stiles and Cleveland are serviced from these points. Plans for the program were begun over a year ago, when it was determined that 70 per cent of the replace-

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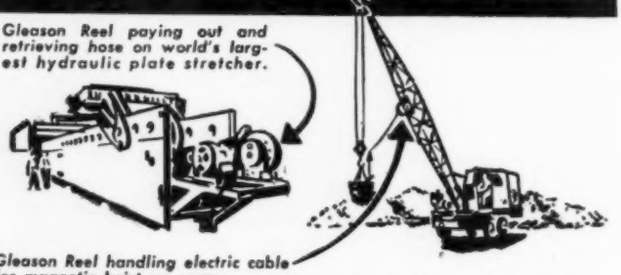
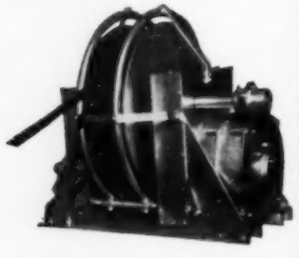
Gleason Reel paying out and retrieving hose on world's largest hydraulic plate stretcher.



Gleason Reel handling electric cable for magnetic hoist on crane.



Gleason reels are made of fabricated steel in various styles and sizes to pay out and retrieve electric cable up to 400 amps., 6,000 volts in length up to 700 feet, and similarly handle hose lines up to 2,000 lbs. pressure and 200 ft. in length. Pay-out and retrieve are automatic by "spring motor". In Gleason's exclusive design, the spring is outside the drum, instantly accessible, replaceable in the larger sizes with a duplicate "packaged" unit held by four bolts. Spring remains safely coiled in its steel cover at all times. Reels have 2-way payout feature, without need for purchasing any attachment. Equipped throughout with heavy-duty ball bearings. Spring does not revolve, which is an important extra-life feature. May be had in watertight construction. Gleason current collector and brush rigging have highest conductive efficiency, virtually never wear out or give trouble. Hose reels have Chicksan Joint which accommodates pressures up to 2,000 lbs. without adjustment.

Gleason Reels appeal to the Plant Engineer because in every detail they are designed and built to operate through the years with always-dependable transmission of electric current or hydraulic pressure, absolute minimum of attention, and unequalled ease of replacement when necessary.

REQUEST CATALOG 548

J. L. GLEASON & CO.

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Distribution has been centralized for faster service.

ment parts could be carried in finished inventory or rough stock. The remaining 30 per cent, mainly parts for obsolete equipment or for special machinery, can be provided within a reasonable delivery schedule.

During the last ninety days, shipments of replacement parts exceeded monthly averages of 1947 and even greater improvement is expected. Enlarged facilities, concentration of engineering records, and a substantially increased investment in inventories made the program possible.

All parts have been grouped into five classes, with delivery schedules set up for each class. For items carried in finished inventory, emergency delivery time is 24 hours, while for obsolete presses, for which no patterns or tool equipment are available, the delivery time is necessarily longer. However, a complete set of drawings for every Bliss press is carefully stored, with machining instructions clearly indicated so that replacement parts can be manufactured quickly to the same standards originally built into the press.

WIRE STRIPPER HAS AUTOMATIC ACTION

▲ A new and greatly improved hand type, pocket size wire stripper called the "Stripmaster" is being announced by Ideal Industries, Inc. Featuring an "automatic" cam action that releases the jaws, the wire may be removed after stripping so the crushing of stranded wire is completely eliminated.

Squeezing the handles grips the wire, cuts insulation and strips — in one operation.

Squeezing the handles grips the wire, cuts the insulation and strips the wire — all in one operation. Then as the handles are released the grippers automatically free the wire and the jaws return ready for the next cut. There is no possibility of nicking or cutting the wire or fraying of wire ends.

The handles are comfortably shaped and have a narrow span to fit easily into any hand. Light (10 oz.) weight

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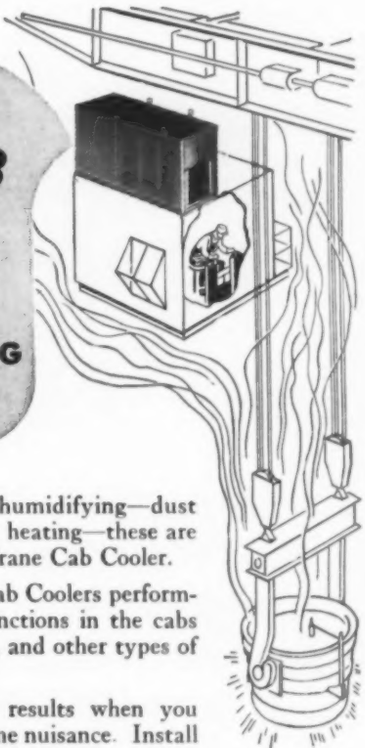

Cooling—fume removal—dehumidifying—dust filtering—ventilating—winter heating—these are the functions of the Dravo Crane Cab Cooler.

You will find Dravo Crane Cab Coolers performing these air conditioning functions in the cabs of soaking pit, ladle, stripper, and other types of hot-metal cranes.

And you will observe real results when you eliminate heat fatigue and fume nuisance. Install Dravo Crane Cab Coolers to provide these comfortable working conditions in the cabs of hot-metal cranes.

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and minimum finger pressure enables the wire stripper to be used all day without fatigue. Just four models handle all wire gages from Nos. 22 to 8.

BATTERY CHARGER HAS AUTOMATIC OPERATION

▲ The Electric Products Co. announces a new completely-redesigned battery charger for servicing the batteries of motorized hand lift trucks. Weighing only 115 lb in its smallest rating, "Chargette" occupies a floor area of just 10⅝ by 14⅝ in.

Ease of operation distinguishes this charger. All the truck operator has to do is to plug together the charging cable connector and to turn the pointer (located in the upper left hand corner of the nameplate) to "Normal Charge" position. Automatically, the charging current begins at the proper value and is controlled throughout the charge at rates prescribed by the battery manufacturer; the charger stops in case of power failure; when power is restored, charging resumes and the charger shuts down completely when the battery is fully charged. Only this type of charging equipment has really full-automatic operation.

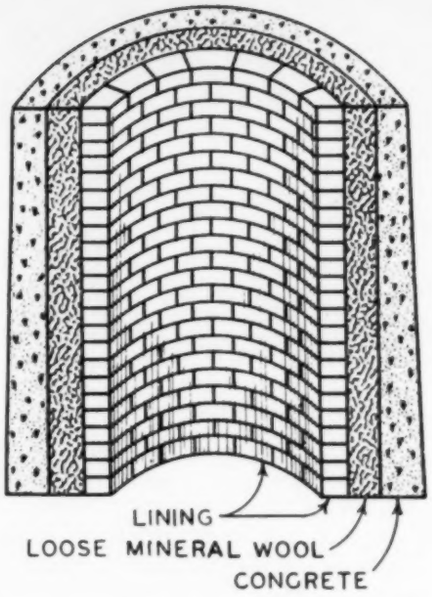
Every part of this new charger is readily accessible for inspection and maintenance. Raising the control box lid, hinged at the top, reveals all control equipment. Removing the helmet-type motor-generator cover (held in position by the quickly-removable lifting eye-bolt) gives ready access to the brushes and generator field rheostat.

LOOSE MINERAL WOOL INSULATES CHIMNEY

▲ To prevent interior stresses in a 554-ft high concrete chimney, the International Nickel Co. of Canada, Ltd., Copper Cliff, Ontario, Canada, has insulated what is believed to be the largest chimney in the British Empire with loose mineral wool insulation.

The concrete chimney-shell had to be protected from stresses resulting from a temperature difference from 800 F on the interior to as low as –50 F on the outside.

The chimney has an outside bottom diameter of 62 ft 1 in., an outside



top diameter of 40 ft 8 in., a top wall thickness of 8 in., and a bottom wall thickness of 33 in. Its total height of 554 ft is lined with perforated radial brick, the bottom 75 ft being 5 in. thick and the remaining upper sections being 4 in. thick. Supporting corbells are protected by special ceramic corbell blocks which permit the

(*Please turn to page 162*)

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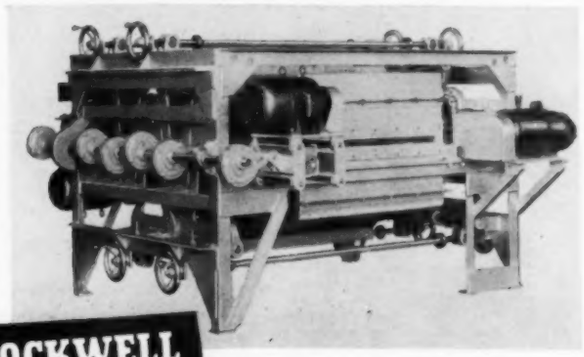

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Provides a continuous, speedy cleaning of steel or non-ferrous strip, for removing thin scale, loose zinc oxide, carbon and foreign matter. The strip, in single broad width or multiple narrow widths, bears against the back-up roll, motor driven at same speed as the moving strip. Adjustable brushes rotate in direction opposite to strip travel and oscillate so as to prevent strip from wearing each brush. Wringer rolls at both ends of the tank wring off acid and clean water.

During brushing, strip is constantly sprayed and loose material is drained off. (The set-up can be arranged for dry brushing.) A hot water rinse is also provided. Designed to your strip cleaning requirements.

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Equipment News

(*Continued from page 160*)

lining to expand both vertically and horizontally.

A space of 4 in. exists between the lining and concrete chimney-shell and it is in this space that the loose mineral wool was installed. Mineral wool was used in this application because when properly applied, it remains in place without settling. It has this property because the fibers of the loose irregular mass knit themselves together and exert internal pressure on every part of the mass sufficient to support every part directly adjacent and above it. The weight of every part is not enough to exert a downward force sufficient to counteract this internal mass pressure which is exerted in all directions.

DIAPHRAGM VALVE SEALS BONNET ONLY

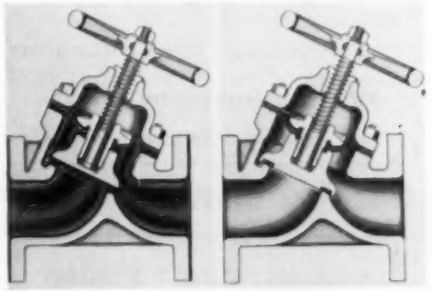
▲ Crane Co. has introduced a line of diaphragm valves utilizing a new design principle that limits the diaphragm function to sealing the bonnet only. A separate seating member, giving positive control of flow independently of the diaphragm, reduces the flexing to which the diaphragm is subjected and completely eliminates the diaphragm crushing action that is inherent in designs where the diaphragm itself is used to effect valve closure. The result is a diaphragm of many times longer life. Shut-off of flow is positive at all times. Even in the event of diaphragm failure, fluid cannot pass on to the line when the valve is closed. The new valve is considerably easier to operate than the diaphragm-closure type. Quicker closing is also a feature. Y-pattern body design gives greater flow capacity.

Two types of valves are available, one plain iron and the other neoprene lined and coated. Both types have bolted bonnets. The plain iron valves are offered in sizes ½ in. to 2 in., inclusive, with screwed ends; and in sizes ½ in. to 4 in., inclusive, with flanged ends. The neoprene-lined-and-coated valves are being made with flanged ends only, in sizes ½ in. through 4 in.

In the unlined valves, a newly designed flat-face disc with neoprene insert has been used to assure tight seating under all conditions. The neoprene-lined-and-coated valves do not have such an insert, for the entire disc surface is heavily faced with neoprene, which makes a seal with the neoprene-covered seat when the valve is closed.

These valves have rising-stem construction, sizes 2 in. and under having the stem rising through the handwheel and the larger sizes having the handwheel rigidly attached to the stem and rising with it.

The diaphragm valve is one of the increasingly popular types of "packless" valves. It completely seals the operating parts of the valve from the line fluid, and eliminates troubles that necessitate frequent packing maintenance in other types of valves.



This new principle of design limits the diaphragm function to sealing the bonnet only.

The new Crane valves are recommended for use with compressed air, compressed and liquefied gases, hard-to-hold fluids, corrosive and noxious gases, for many types of corrosive process fluids, solvents, natural and corrosive waters and for sewage and other such fluids. They may be used to replace any other diaphragm valves, or conventional gate or globe valves. The plain iron valves are designed for services not exceeding 150 psi pressure and 180 F temperature. Temperature limitations on neoprene-lined-and-coated valves are dependent upon service conditions and the fluids carried. The neoprene-lined-and-coated valves are especially recommended for service with fluids corrosive to iron but non-active chemically upon neoprene, and for services where abrasion is a major destructive force.

Where abrasive dusts are present, or where there is danger from rock slides such as in mine operations or in rock-hammer operations in construction work, a cap to protect stem threads can be supplied for valves of 2 in. and smaller sizes.

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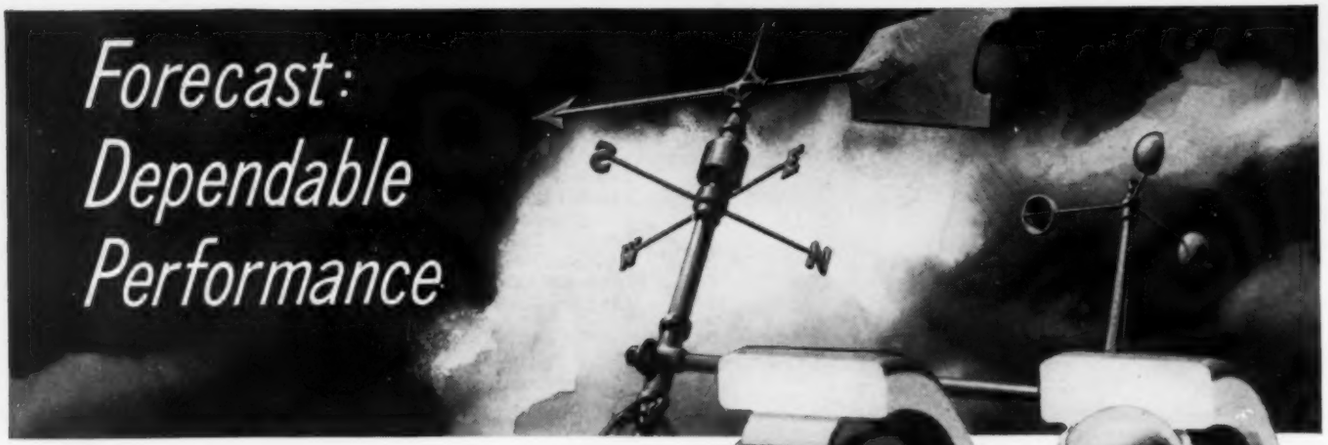

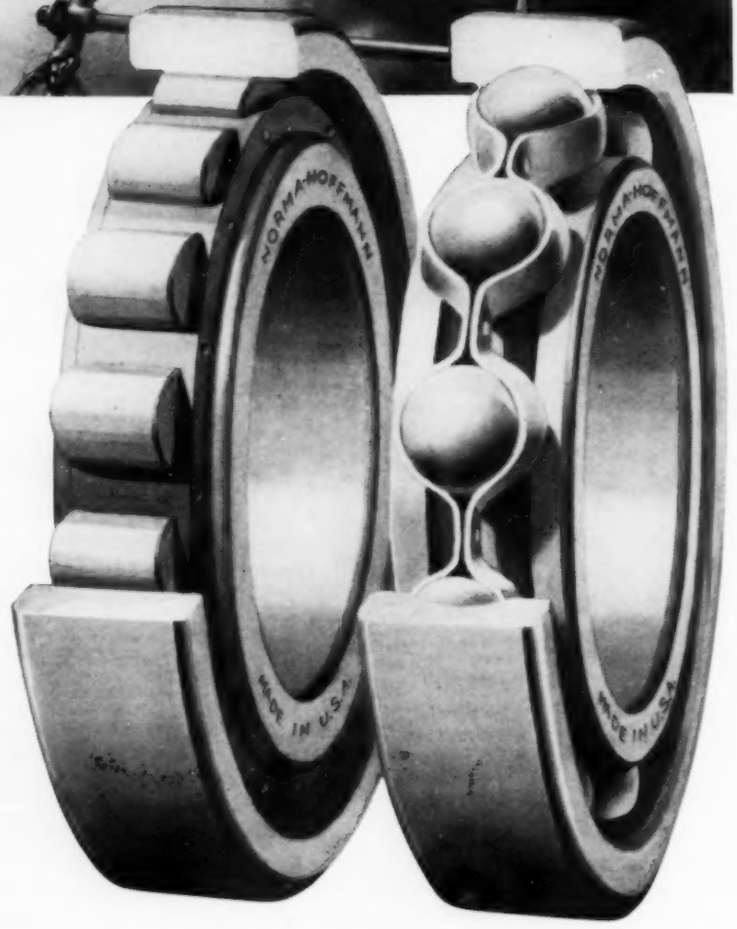

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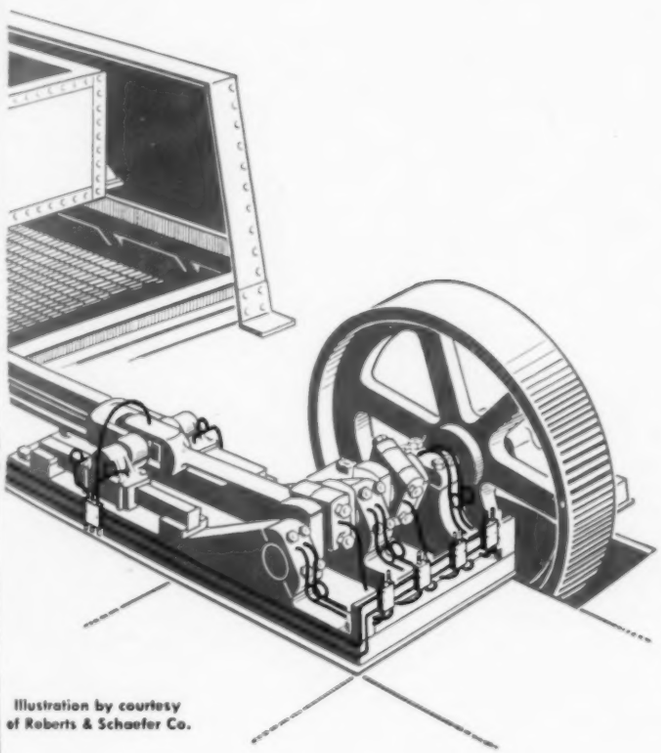


Illustration by courtesy of Roberts & Schaefer Co.

TWO men used to spend all their time lubricating the drive of the world's largest Marcus shaker screen, located in a West Virginia tipple. They had to use an expensive graphite grease, and it required 300 pounds a week to hold the bearings.

Finally, in order to relieve this situation, the company installed a Farval automatic centralized system of lubrication. They were able to cut off the two oilers, saving $160 a week. With Farval they were also able to use a much cheaper grease—and further, used only one-third as much, saving another $30 a week. Thus an annual dollar saving of more than $9600 was realized on labor and lubricant alone, not to mention the increased life of the bearings and the elimination of shutdowns and delays.

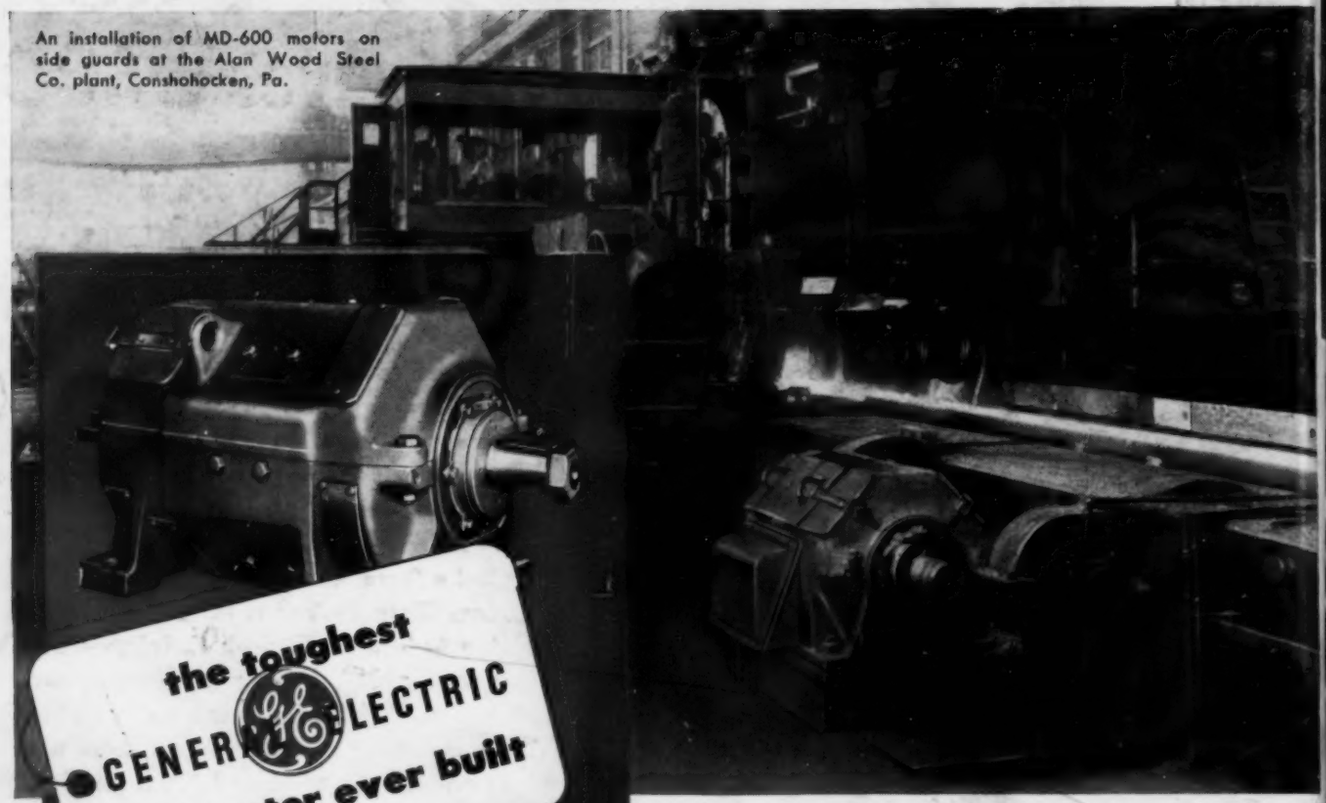
Farval centralized lubricating systems have been serving the coal industry for more than 17 years. In preparation plants, Farval lubricates Feeders, Crushers, Conveyors, Shakers, Vibrating Screens, Elevators, Washers, Jigs, Dryers, Mixers, Loading Booms and Drives.

Farval delivers oil or grease under pressure to a group of bearings from one central station, in exact quantities, as often as desired. It does its work while the equipment is in operation. Farval is the Dualine System with the Positive Piston Displacement Valve. This valve has but two moving parts and is fully adjustable, with a Tell-tale indicator at each bearing to show the job is done.

Write for Bulletin 25 for a full description of Farval. The Farval Corporation, 3278 East 80th Street, Cleveland 4, Ohio.

Affiliate of The Cleveland Worm & Gear Company, Industrial Worm Gearing. In Canada: Peacock Brothers Limited.

FARVAL—*Studies in Centralized Lubrication* No. 108



An installation of MD-600 motors on side guards at the Alan Wood Steel Co. plant, Conshohocken, Pa.

the toughest GENERAL ELECTRIC mill motor ever built

... gives you 5-way convertibility WITH ONE BASIC FRAME!

Protected, self ventilated

Protected, with blower

Totally enclosed, back geared

Totally enclosed, force ventilated

MD-600 MILL MOTORS

Meet the new AISE industry standard!

You save the cost of extra standby motors—plus change-over time and storage space—because of the universal frame construction of General Electric MD-600 mill motors. To meet changing mill conditions, you simply change the enclosure or blower.

Covers for all five types of enclosure fit the basic motor frame and make this a really adaptable mill motor. Rectangular openings in the bottom and ends of the motors permit self-ventilated, force-ventilated or blower construction without need of a special frame.

Moreover, these industry-proved, extra-tough MD mill motors assure you the benefits of improved insulation for longer life and new convenience features for ease of maintenance. Costly downtime is cut, too, by such features as full-length commutating poles that permit 25 to 35 per cent greater overloads; more effective armature cooling; and a pressure-relief greasing system that keeps the motor interior grease-free.

You can get most standard ratings of MD-600 motors within 18 weeks; others within 28 weeks. Check your G-E representative for details. For technical data, write for Bulletin GEA-4654. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

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